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THE

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THE POSSIBLE STERILISATION OF CITY WATER SUPPLIES BY MEANS OF ELECTRICITY.

THE experiments which have been made during the last year or two in examining into the action of electricity upon protoplasm, and especially into its action upon low aquatic forms of life, have suggested the possibility of making use of this powerful agent in the sterilisation or purification of water. The question is being asked why, if electricity under certain conditions will destroy bacteria, the attempt should not be made to destroy bacteria wholesale in the drinking water of large cities.

Mr. R. Meade Bache, of the American Philosophical Society, is one of those who believe in the possibility of thus purifying our water supply from bacterial contamination, and he has been led to this conviction partly by his own experiments as well as by watching the researches of others.

It is generally considered that some of the worst forms of pathogenic germs reach us through the medium of drinking water, and hence the success of sterilising our supplies of this necessary of life might be of untold benefit to human health.

There are a great many difficulties in the way of applying electricity. We cannot electrolyse successfully a large reservoir of water, for the electricity would be too diffused to be effective. Then, in pipes from which water is flowing into or out of the reservoir, any germs which might be present would not be subject to attack for more than a moment of time. Moreover, the resistance that has to be overcome in water is large.

But, on the other hand, the electric current that we now have at hand is capable almost of indefinite increase. The electromotive force of a few thousand volts thrown across a pipe of suitable dimensions would probably, says Mr. Bache, paralyse every bacterium in its path, more than compensating by force for the slight duration of time.

In discussing this subject before the American Philosophical Society, Mr. Bache gave an interesting account of his own researches, which were of a more or less affirmative character; he also argues the possibility of purifying water supplies by means of electricity.

It is an open question whether or not the stomach is capable of destroying pathogenic germs, and in that, of course, is involved the other open question, whether or not ordinary drinking water is the source of disease. The questions are spoken of as "open," because many eminent authorities are enlisted on opposite sides; but at the same time most people consider that the drinking water supply is ordinarily one of the largest factors in the causation of some zymotic diseases. The action of electricity seems to point out at least one way in which the evil may be mitigated if not absolutely removed.

That there are considerable difficulties in the way of

applying electricity to the sterilisation of water, that is to say, to the destruction of all harmful germs that it may contain, no one will be disposed to deny; yet, considering the vast interests at stake in a large city, some essay might be undertaken, and at no very great labour or expenditure, to see whether electricity could be thus employed. At least, it behoves all who are competent to discuss the question to consider whether any scheme of "electrical sterilisation" bears upon it evidence of practicability, and if so, to push forward such schemes with vigour, because they suggest new lines of work—and valuable work, too—for the electrical engineer.

MAGNETISM IN TOOLS.

IT is a well-known fact that drilling and other tools frequently become slightly magnetic after they have been in use a few minutes, so that iron and steel dust will often cling tenaciously to certain portions of their surface. The cause of this magnetisation has been attributed by some to the heat developed in doing the work, but this explanation is scarcely tenable, for if such were the case, all portions of the drill or other tool which were equally heated would show an equal intensity of magnetism, which is not the case. It is most frequently noticed that it is the point and corners which show the greatest power of attraction, while with a twist drill it sometimes occurs that one edge along the full length which has penetrated the metal is more or less strongly magnetised; but the opposite side will show barely a trace of magnetism, and another drill of the same kind will be found to be strongly magnetised at the point only.

That heat has but little, if anything, to do with the magnetisation of tools is shown when an attempt is made, by the use of this form of energy alone, to develop the magnetic property. Such attempts uniformly result in failure to produce any indications of magnetism.

The position occupied by tools with regard to the magnetic meridian has also been suggested as a cause for their becoming magnetised, but on examining into a large number of cases it cannot be considered that the direction in which tools lie or stand when at rest can have any perceptible effect on the development of magnetism in these tools when they are at work. There are examples on both sides.

A writer in the *Stationary Engineer*, in discussing this subject, states his opinion that friction has a good deal to do with producing the magnetism. If a drill that has become magnetised while at work be closely examined, it will be found that the magnetised parts are those which have been slightly worn by friction, but if the friction is sufficiently great to cause perceptible heating, then any magnetic effect that may have been produced, or was previously there, is destroyed.

Lathe and plane tools frequently become magnetised while doing work. The same is often observed in the case of cold chisels, and is most frequently noticed in such tools as are soft enough to stand considerable work without breaking, and yet hard enough to hold an edge. These facts are in agreement with the well-known fact in science, that a piece of steel that is but slightly hardened makes a good magnet, but does not retain its magnetisation as long as does harder steel, which is, however, more difficult to magnetise, being less permeable, but more retentive.

It would be an interesting, and by no means difficult task, for some of our young electrical engineers to make note of every case of magnetism in tools which they meet with. If these notes were made intelligently an accumulation of them might lead to some interesting deductions.

Gas and Electric Light.

IT generally happens where the electric light is introduced that the consumption of gas increases. At Cologne, however, the reverse has proved to be the case. The competition of the electric light has resulted in a diminution in the use of gas in so far as private individuals are concerned. Although during the past financial year the number of private customers to the municipal gas-works augmented, the consumption of gas by such persons decreased by 58,900 cubic metres as compared with the previous year. This is explained by the extension of private electric light plants. The diminution in the use of gas amounted to 13½ per cent. in the case of factories, to 2½ per cent. in warehouses, and to 1·86 per cent. in wholesale establishments and on private premises. The municipality proposes therefore to reduce the price of gas and especially for cooking and heating purposes, and by this means it is hoped to be able to increase the rate of consumption.

Hoist with his own Petard.

MR. CUTHBERT HALL, surely the gentleman of fault-finding fame (in cable cores), recently wrote an article for a contemporary upon the subject of "The Profession of Electrical Engineering." In the last number of the said journal letters appeared from Mr. Hugh Erat Harrison and Mr. Sydney F. Walker, in which Mr. Hall's statements are severely, but justly criticised. Mr. Harrison states that the article is calculated to seriously mislead those who contemplate qualifying themselves for the profession. The author suggested three "alternative" methods of training which are (1) a university course followed by an apprenticeship to a firm of electrical engineers; (2) an apprenticeship to a firm of electrical engineers only; (3) a one, two, or three years' course at a technical training college. He particularly called attention to the case of a gentleman who after spending enormous sums on college education, and a further sum with a firm of engineers, amounting together to £1,100, is now—after six years' training—receiving only £100 per annum. He seems to take this as a standard example of what it costs to become an electrical engineer. Mr. Harrison, however, very properly states in his letter that a man like this, who will not or cannot, look after his own monetary interests, is not likely to be of any service, from a commercial point of view, to the firm which employs him, and the £100 a year must probably be regarded as a charitable gift to a person who has mistaken his calling, rather than as a salary for useful services rendered. Mr. Hall has, as so many people do, simply considered the training and entirely overlooked the characteristics of the man himself. Mr. Walker seems to argue in very much the same strain as Mr. Harrison. As a clearer illustration of his statements he says that a particular ingot of steel may be rolled into rails worth a few pounds per ton, or it may be drawn out into watch springs worth over £1,000, but for the latter purpose inferior steel would be useless. College education for an electrical engineer is surely not an absolute necessity to enable him to fit himself for the higher positions, which if circumstances are favourable, he may occupy later in life. Mr. Walker states, however, that an engineer, and particularly an elec-

trical engineer, has many ways of making opportunities of showing his knowledge and skill, and of forcing his way to the front. That is the great advantage, apart from the fascination of the work, of belonging to some branch of engineering. There is an old adage which reads "Once bit, twice shy," but such old world wisdom seems to have no meaning for Mr. Hall. Still, with this second rebuff it is to be hoped that he will in future submit his opinions to the kindly criticism of older heads than his own before rushing into print only to be ruthlessly crushed by the mere weight of experience.

Corners in Rubber.

WHILST the users of gutta-percha are troubled by the unpleasant prospect of a considerable falling off in the supply of the raw material, rubber manufacturers have to meet the difficulty of getting their supply out of the hands of financiers, who lay themselves out to buy up the raw material with a view to creating a corner. We do not know what there is in rubber which exercises such a peculiar fascination on Gonçalves Vianna, or how it is that this active speculator, after two failures, has succeeded in getting so much support in his third venture; but the fact remains that he and his coadjutors have managed to upset the rubber market for some considerable time, and that the syndicate was only broken by the increased output of rubber from Brazil coming whilst they held, according to some estimation, about 3,600 tons; a stock which had accumulated owing to the small buyings of manufacturers, and to the increased use by them for many classes of goods of other rubbers than Para. Vianna's last venture, which has recently collapsed, at no time caused such high prices and so much inconvenience as his attempt to control the market in 1882, when rubber went up to about 5s. a pound, and it was found necessary by the American manufacturers to agree to suspend all work, and to buy no more rubber until further notice. This year there has been no need for such drastic measures, probably owing to the increased supply of rubber from other places than Brazil, and to the improved processes for working these rubbers, and the Vianna Syndicate has been broken by the want of capital sufficient to buy up this year's crops, whilst still encumbered by enormous holdings, which the manufacturers would not buy whilst it was possible to carry on their factories without it. It would appear from these failures that a corner in rubber is a bigger job than most men can tackle, and we sincerely hope that this will be the view of Vianna and his backers, and that after this, the third unsuccessful attempt, they will cease from troubling, and let the rubber trade have a fair chance.

Artificial Rain-making.

THE electrical section of the Franklin Institute, U.S.A., has just been entertained by Prof. Edwin J. Houston with a paper upon the subject of artificial rain-making, in which he endeavours to answer the question: Do the scientific facts, as far as they are known to meteorology, give any encouragement for the continuance of the efforts of would-be rain-makers? The professor carefully examines the arguments which are brought forward in support of the theories by these civilised contemporaries of the savage "rain-maker," and comes to the following conclusions which he thinks may be drawn in view of the present state of meteorological science:—1. That rain can never be made to fall at will by mid-air explosions on any part of the earth's surface, irrespective of the climatic conditions there existing. 2. That during certain meteorological conditions, "mid-air" explosions may result in rainfall over extended areas. 3. That the liberation of energy necessary for such rainfalls is due not to the "mid-air" explosions but to the energy stored up in the moist air from which the rain is derived. 4. That the meteorological conditions which must exist for the successful action of "mid-air" explosions would probably, in most, though not in all, cases, themselves result in a natural production of rain. 5. That a comparatively high difference of electric potential between different parts of the air, or between the air and the earth, is possibly favourable when taken in connection with other meteorological conditions for artificial rain-making. 6. That an undirected "mid-air" explosion is not as likely to produce rain as an explosion in which the main tendency of the energy liberated is to cause a general uprush of the air. Hence, if advantage is to be taken of favourable meteorological conditions when these perchance happen to exist, it will be necessary to have aerial stations—captive balloons, containing registering electrometers, telethermometers, telehygrometers, teleanemometers, &c., &c., which might be connected by wires with recording apparatus placed on the earth's surface. We don't know what all this would cost, neither do we presume to say what benefit it might be to the "science" of rain-making; but if such aerial stations of observation could be established they would probably give some material assistance to the general operations of the United States Weather Bureau.

The Measurement of Time of Rotation.

A NEW departure is recorded in the methods of determining the time of very rapid rotation, by K. Prytz, in the *Annalen der Physik und Chemie*, which is worth noticing in these pages for the benefit of any of our readers who may be engaged upon researches in which such a method might very likely be of use. The usual methods of determining the time of very rapid rotation commonly depend upon the contact of a stylus fixed on the limit of a tuning fork with a rotating wheel or cylinder, or on the use of the electric spark with a pendulum to indicate the time of rotation. But the new method which has been worked out by K. Prytz, employs a falling body, upon or against which the rapidly rotating body spirts a fine jet of some liquid colouring matter. In the *Annalen*, 1891, No. vii., pp. 638—651, this rather remarkable method is fully described, and examples of determinations of time by means of it are given. If the recorded results are to be trusted, it would appear that in this new method of determining time, we have an adjunct which is likely to be of great service in many departments of physical research, for Herr Prytz says that the time of a complete revolution of his apparatus could be determined to the 0·00002 of a second!

Electrocution.—Australian Opinion.

AT the last meeting of the Victorian Institute of Engineers, Mr. K. L. Murray referred to a paper he read some time ago on the subject of "Recent Developments of Electricity." In his remarks he made special reference to the recent executions by electricity in America, full particulars of which he said he had received in papers sent to him from New York; but, unfortunately—we quite agree with him that it was unfortunate—he had left his notes on the subject at home. He thereupon proceeded to utter the most erroneous statements; in fact, we think it would have been just as well if he had done the same with his words as he did with his notes, for they are most misleading to those who have not followed the whole matter closely. Our readers will remember that we published an article on the subject in our issue of July 10th, page 44, when we stated that the dynamos were tested to 3,000 volts, the strength used, however, being only about 1,500 volts, whereas Mr. Murray, when questioned, stated that about 6,000 volts was the electromotive force employed. Further, he said that he "had frequently expressed a doubt as to whether a man could be killed by electricity, but, of course, meant by shock, as he had never doubted that a man could be burned to death if the current were applied for a long enough period." Here again, is to say the least of it, a

most absurd assertion, and we wonder the speaker likes to display his ignorance in this way. Anyone in the least degree connected with electrical matters, must surely have repeatedly had brought before them instances of persons having been killed merely by a shock. As for the 15 ampères which Mr. Murray thinks was the current used, the resistance of the criminal's body must have been but little over 100 ohms to produce such a result, and if he had followed the researches of the late Dr. Stone and others, he must have known, or a little calculation would have made him aware, that such a low figure was not to be expected. We cannot congratulate the Victorian Institute of Engineers on the reliability of the information they are likely to receive from Mr. Murray if this is a specimen of the method he adopts of becoming acquainted with topics of the day.

Electricity and the Manipulation of Explosives.

IN compliance with a very generally expressed wish amongst those who are interested in the effects of modern explosives upon the health of the people who have to operate with them, a committee was formed about two years ago of the Durham Coal Owners' Association to investigate this subject. The committee consisted of representatives of both masters and men with two of Her Majesty's Inspectors of mines. The general conclusions arrived at by the united experts, chemical and medical, have been recently drawn up and published, from which it appears that modern explosives are not more injurious to health by reason of their fumes, &c., than is gunpowder. But we notice that all are agreed that the old time-fuse should be uniformly discarded and that in future the charges should be fired by electricity.

Condensation in Steam Engine Cylinders.

NOWADAYS so much of the commercial success of any undertaking using steam power depends on the reduction of the coal bill to a minimum, that any hints as to probable methods of increasing engine efficiencies is much to be welcomed. On June 24th, we published the only account of Prof. Hall's experiments given by any technical paper, and the *Engineer* of October 16th, gives a short criticism of that paper by Prof. Fitzgerald. He points out the manifest advantage of Prof. Hall's thermo-electric method of measuring temperatures over the thermo-metric one employed by Mr. Bryan Donkin in his researches. The superior capacity in the latter case must largely damp out the oscillations of temperature, besides causing the rise of the thermometer to lag behind the impressed temperature to a somewhat unknown extent. All these methods of determining the temperature gradient by holes not on the same radius of the cylinder, must be subject to more or less error, as we do not know whether all the gradients for every radius are the same. Prof. Fitzgerald gives a method of building up an indicator diagram from an assumed temperature curve in the cylinder; this, if further carried out, would doubtless yield some interesting results. The reverse process might also prove interesting, and lead to some further insight into the matter.

Where to Draw the Line.

IT will be observed from a perusal of our "Notes" columns that the Corporation of the City of London has decided to use the electric light in the temporary home of its chief civic magistrate. Judging from information which has reached us it appears that much dissatisfaction exists in the electrical trade at the reports as to the manner in which this contract has been given out, for it is asserted that several firms who tendered, did so for special reasons, at prices which, on certain portions of the work, were not above that of actual cost, yet it is said the work has been put into the hands of contractors whose tender is some hundreds of pounds below the lowest of the others. It is also said to be well known to those who are entrusted with the granting of the contract, that the accepted estimate is much below the sum at which the installation can possibly be made without loss, and the question is raised whether, assuming the facts are correctly stated, the Corporation of London has any right, when the interests of the citizens are taken into consideration, to give out contracts on these essentially bad conditions. It is evident that the time is at hand when some hard and fast line must be drawn amongst electric light contractors to control to a certain extent the prices at which given work shall be undertaken so as to leave the chance of a reasonable profit, otherwise it seems useless to continue the business as a means of livelihood. The cutting down tactics are of no avail in the long run; if people want the electric light they will be content to pay a fair price for it. Supplying at less than cost price does not influence the public who know nothing about its details, but it has a baneful influence upon the members of the trade who are desirous of making a living from moderate profits, as st has a tendency to deter first class contractors from tendering at all. It is very well to quote low terms for the sake of getting the advertisement that so and so lighted the residence of the Great Mogul, but if it happens that the work is abominably carried out the harm done is incalculable.

Objectionable Trades Unionism.

AN electric lighting contract in the country was given into the hands of a London firm who thought it expedient to employ local labour at 6d. per hour under the supervision of one of its experienced wiremen. The estimate, indeed, was made out on this basis, but when it became known to an Electrical Trades Union that the work was progressing, delegates were sent from town to warn the countrymen, who appeared quite contented with their lot, that they must not continue their avocation under 1s. per hour, unless they wished to be visited with all the dire penalties which the union is capable of inflicting upon them. Why do not employers combine to put a stop to this kind of terrorism? Even in the newest of industries with all the uncertainties attached to the successful carrying out of the work entrusted to their care, the freedom of the British workman is a thing of the past, and he must yield to the dictates of the union, however unreasonable may be its demands. Perhaps the better informed amongst them may some day think it desirable to institute an anti-trades union, and then the supremacy of British manufactures and British unfettered labour may again re-assert itself.

The International Okonite Company.

NOW that this company's balance sheet has been issued and the first meeting held, attention is being attracted to its affairs, and some of our contemporaries are making remarks and asking questions identical with those which appeared in our article criticising the prospectus when it was issued. The *Daily Oracle* regards the results disclosed at the meeting to show that "the whole business was about as bad an instance of wretched *fiasco* and deceived hopes as one could well rake up among the modern instances of such things;" and it concludes its articles on the subject by saying that "it would seem desirable that the shareholders in the International Okonite Company should observe all speed in looking closely into their undertaking and sifting its real inwardness from the start to the present time." Doubtless this would be desirable if properly done, the shareholders bearing in mind that they have to earn an income from manufacturing a product, and that an unenviable notoriety in the case of the company itself might affect the sales of its product. By setting its house quietly in order at once it might save another balance sheet of so unsatisfactory a nature as that now issued. The shareholders will probably conclude that their salvation lies—if the apparent paradox may be excused—in keeping the going business going, and letting the non-going business go.

BLOCK SIGNALLING.

An interesting article appears in the October number of the *Engineering Magazine*, entitled, "A Solution of the Block Signal Problem;" interesting from more points of view than one, but from none more than the confidence displayed by the author in his selection of a title for the article, and in the manner in which he deals with the question. After a slight sketch of the means by which that system of working trains, denominated the "block system," became established, the article proceeds to point out the means generally adopted for working railway traffic under this head; and then proceeds to explain the method proposed by himself, and which, it is perhaps needless to say, is "the solution of the block signalling problem." It is generally known that railways in the United States largely favour automatic signalling; that is, the signals are operated by the trains and not by hand, as is done in England, and as we learn from the article, is in operation on the Pensylvania Railroad. Mr. Ward Leonard, the author of the article, regards the cost of hand signalling as prohibitive. "The great expense in establishing and maintaining it, together with the fallibility of operator and inspectors, renders it impracticable except in rare instances." The cost "per block" is set down as about $1,500 per year. The cost of the automatically-worked signals ranges from $65 to $135 per signal per annum. So far as we can judge, we should consider the estimate a very reasonable one. Many signal boxes in England cost very much more than £300 a year to man and maintain, and few cost much less. Apparently, what Mr. Leonard aims at is to get rid of signal boxes, and to work entirely upon an automatic system. The system devised by him, and evidently worked out with much thought and intelligence is automatic in every sense. Broadly it is thus described: "Divide the line of the railway into blocks of, say, one mile long. Make each block overlap the next one half way. Stretch a bare wire parallel to the track and continuous along each block. Thus a wire one mile long will start from the beginning of each block, and another parallel to the first will start at the centre of the first. There will thus always be two parallel conductors along the track, and a conductor will end and a new one begin at each half mile. The forward end of each mile length of conductor will be connected by a wire leading to a green incandescent lamp, and the other terminal of the lamp will connect with the ground. Similarly the rear end of each conductor will connect with a red incandescent lamp. Upon each locomotive will be placed a generator of electricity of about 100 volts;" a battery or dynamo, one pole of which is grounded, the other being through an ampèremeter to "a low resistance series incandescent lamp, which, when supplied with the current of four of the track signal lamps, will operate at a moderate incandescence," conducted to a "trolley carrying a large wheel made after the style of a bicycle wheel," which conveys the current to the wires upon which it travels. Lamps may be arranged along the track in connection with the track wires, so that the line of railway and stations may be lighted up as the train travels, for a distance of half a mile, or thereabouts. As the train moves along it will have in front of it—at the end of the half mile, as also of the mile section it is traversing—a green lamp in front of it and a red lamp behind it; and as it passes from the one section to the other the lamps of the one section vacated will be extinguished, and those of the new section entered will be illuminated, as will also any lights placed along the track or station buildings." Thus any following train would have to pass two red lamps before coming into collision with the train in advance of it. It is also claimed that whenever trains are within a mile of each other the electrical generators would be "in concert to divide the combined loads of the two, and whatever the current of each had been previously, it would immediately become different, the generator having the higher pressure taking the larger portion of the combined load. Thus the pilot lamp of one locomotive would flash up and its ampèremeter would indicate a greater current than usual, and this, by a contact on the ampèremeter needle, would cause an alarm bell to ring in the cab." Provision is also suggested for enabling the drivers or others in charge of the trains to hold telephonic communications, and so adjust their differences. There are other provisions and suggestions which the space at our command will not, however, admit of our dwelling upon; nor is it, perhaps, necessary that we should do so.

Ideas of the character here enunciated, and in some instances bearing a very near resemblance, have from time to time been brought under the notice of English railway authorities, but in no single instance have the inventors or promotors succeeded in inducing railway companies to adopt, or even to make a reasonable trial of, any one of them. We do not attempt to follow Mr. Leonard in his argument as to the action of the one, two, or three dynamos of the trains, which might perchance happen to arrange themselves upon the same block section. The problem is a somewhat complicated one, especially when we have to deal with lighting currents conducted by the means proposed; but of this we are assured, that in practice such a system would not be found to possess that roseate hue accorded it in Mr. Leonard's article. Mr. Leonard may rest assured that he has not, by the means proposed, succeeded in solving the "block signal problem." He may, moreover, rest assured that as traffic increases, and American lines become as densely packed with trains as are the English lines, no automatic system of signalling will be tolerated. The only safe plan upon which automatic signalling can be based is that when any failure in the apparatus arises, the signal shall fall to danger. Granted this is the system pursued, every failure must mean stoppage of traffic. This stoppage can only be cleared by some regulation under which the trains can pass on without the aid of the automatic signal. The stoppage itself, independent of the relief system—whatever it may be—must prove a source of danger. Automatic apparatus has no witness of its operations. It may be tampered with. It may, by mishap, or by malice, be made to render a false signal. In England the view entertained is that the working of railway traffic, involving, as it unquestionably does in every case, more or less the lives of those travelling by the trains, requires the presence of a responsible agent for the manipulation of the signals by which the movement of those trains is governed. To this our friends will come as surely as have we. Every accident which occurs, in which human life is involved, demands that the responsibility for that accident should attach to some one, and that its cause should, with the object of preventing recurrence, be ascertained. With responsible agents this may be done. With automatic apparatus, responsibility is cast to the wind. The question is not one of cost, but one of efficiency—at least, such efficiency as shall ensure security of life and limb, or place the responsibility on the shoulders of those by whom any mishap which may occur is brought about; and this American authorities will recognise as well as we.

ELECTRICITY IN THE CLOUDS, PRODUCING RAIN, AND PREVENTING HAIL AND RAIN.

By A. M. TANNER.

The monopoly which Jupiter Pluvius has heretofore possessed in rain making is being boldly infringed by the United States Congress. As is well-known money was appropriated by it for the purpose of producing rain in the arid regions of Texas by the explosion of dynamite in the air. These experiments have been carried out with a certain degree of success; at least the American journals state that rain fell within 60 miles of the point of explosion, in a locality where rain was seldom known to fall. Obviously electricity was an important factor in carrying out these rain-producing experiments, since the dynamite bomb carried up into the air by a balloon was exploded by wires connecting the balloon with an electric battery and circuit closer on the ground. Some American journals are satisfied with the results achieved by General Dyrenforth who conducted the experiments, and proved himself as mighty as the ancient raingod. Others associate his name with that of the great American, of whom Mirabeau said "he wrenched lightning from the heavens and sceptres from kings." Other papers, however, are not satisfied with what has been done in producing rain, and they insist that some genius should now appear upon the scene with a method

for preventing rain. Not until then will they admit that the wet element—of which it is said that the Kentuckians only use it for bathing purposes—is under control and enslaved by man. Here is an opportunity for some one to startle this close of the century with an epoch-making invention. Cannot the calorific effects of electricity be brought into service for desiccating rain clouds? Balloons bearing electrically heated surfaces might be sent up into the cloud regions in sufficient numbers to evaporate the moisture or rain by contact with the heated surfaces. All vapours generated would of course ascend into higher regions, or if they did descend to earth they would be in the form of a London fog. This would be a transformation of rain into floating vapours, and already a step in the direction of preventing aerial moisture, in any form whatever, from descending to earth. The writer is not in a position at present to verify the fact by the citation of name and date, but is certain that a United States patent granted some ten or twelve years ago is for the rain producing method, of which so much has been said and written in America and elsewhere. It appears also that a patent was granted in Austria on January 13th, 1874, for what is termed an "apparatus for discharging electricity from hail clouds." After describing the theory of the formation of hail the patentee says that if a balloon armed with metal points or covered with metal, is sent up into a lower hail cloud charged with electricity, the latter passes to earth by the copper wire which holds the balloon captive, and the moisture in the cloud does not congeal but drops to earth in the form of rain. The drawing annexed to the patent shows a balloon with metallic points and a windlass on which is coiled the wire or cable for forming the ground connection and raising and lowering the balloon. It is within the writer's knowledge that various methods were suggested long before the year 1874 for collecting and utilising atmospheric electricity by means of balloons armed with metallic points and connected to wires leading to earth. As a method of preventing hail the Austrian patent possesses novelty. Whether or not it will operate as claimed is a question which the writer does not attempt to answer, particularly as the patentee was an engineer of considerable repute.

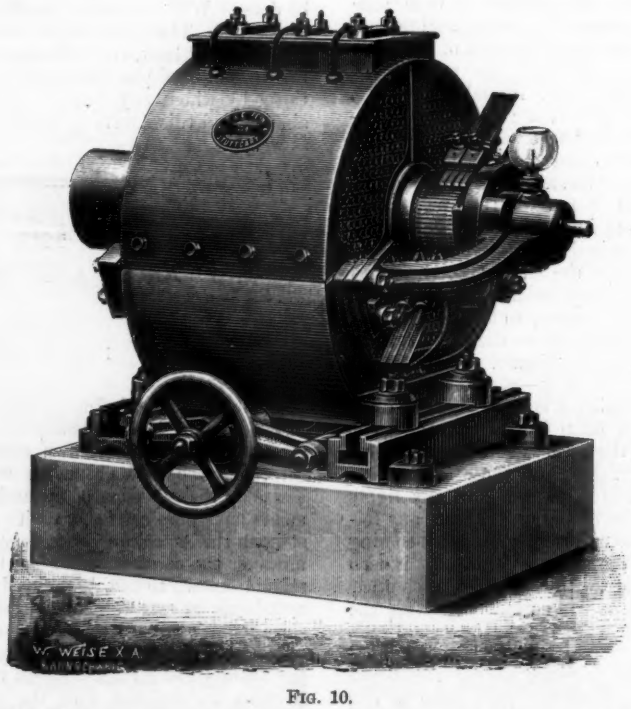


FIG. 10.

THE DYNAMOS AT FRANKFORT EXHIBITION.

BY W. B. ESSON.

III.

A GOOD show is made by Messrs. C. and E. Fein, of Stuttgart, who exhibit both exterior and interior-pole machines. The type of bi-polar machine made by this firm is shown in perspective in fig. 10, the largest example to be seen in the Machine Hall, giving 20 kilowatts at 700 revolutions per minute. The machine has a Gramme wound armature, and is compound wound for a difference of potentials of 110 volts.

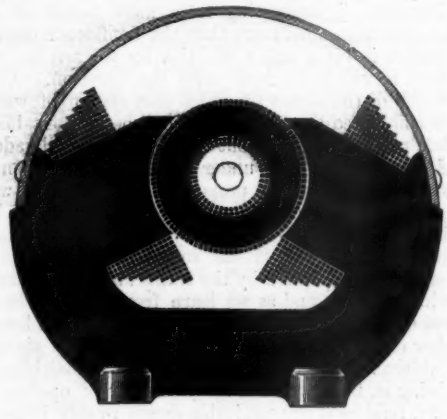


FIG. 11.

A section through the field is given in fig. 11, the bedplate forming the yoke, and magnet cores and yokes being cast together.

At one time, Messrs Fein employed for their two-pole machines the upright single magnet, having its limbs parallel to each other, but they found, as have most other constructors, that unless special precautions were taken, the distribution of the field over the poles was far from uniform and much stronger on the lower than on the upper side of the armature. This want of uniformity was unusually noticeable in Messrs. Fein's machines on account of the cavity for the armature being bored half through the magnet cores, while at the same time the latter were thinned down considerably on the outside. The effect was to strangle the induction, if we might so put it, and to consequently intensify any tendency to uneven distribution already inherent in the type. The makers set themselves to get rid of this defect, and occupying an intermediate place between the magnet with parallel limbs and the form finally decided upon came the design shown in fig. 12, where the magnets are placed diametrically opposite and the yoke split. For uniformity of distribution this design leaves nothing to be desired, but it will be seen that the yoke is very long, which alone makes it heavy, while if

the weight is not farther increased by giving it extra section, the magnetising force required is much greater. The arrangement in fig. 11 must be regarded as a sort of compromise between the two extremes of placing the cores parallel to each other and placing them opposite. It in a manner gets rid of the disadvantages of both designs, for the yoke is not long enough to render the magnetising force excessive, and the want of uniformity is not sufficiently pronounced to become a practical objection. In this design the weight is mostly at the bottom, where it should be, and the neat circular form of the exterior is maintained by a sheet metal casing.

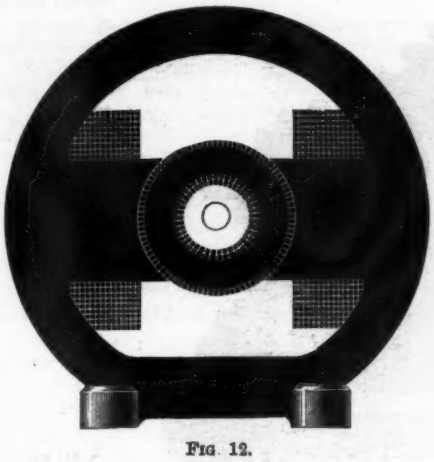


Fig. 12.

The armature of the two-pole machine is built up of soft iron washers, separated from each other by paper and clamped together by insulated bolts passing right through them, also through strong end washers into which the nuts are countersunk. The ring so prepared is wound in the usual way and this completed, it is mounted on the shaft, the attachment being made by clamping the ends between two star-shaped brass castings sliding on feathers. These star clamps are pulled together by through bolts, leather washers being first interposed between the winding and the projections to prevent damage. It will be observed that the driving is by friction only, and though it is said to have given satisfaction in Messrs. Fein's machines hitherto, it constitutes a method of attachment long since discarded on this side of the Channel.

The type of multipolar machine exhibited by Messrs. Fein is shown in perspective in fig. 13. Machines of this class are made with four, six, or eight poles. The radial magnets, yoke and bed-plate, are all in one casting as shown in the section, fig 14, there being no pole shoes and the magnet cores being very short. The armature is of construction similar to that of the two-pole machine already described and the commutator segments are cross connected so that only two collecting brushes are required. The four-pole machine of this type shown by the firm gives 7,700 watts at 1,000 revolutions per minute, and is compound wound for 110 volts. The armature has wound on it 8·5 kilogrammes of copper, the current density in the conductor being 3·5 ampères per square mm. The density in the series and shunt winding is 2·0 and 2·06 ampères per square mm. respectively. The resistance of the armature warm is ·04 ohm and the resistance of the series winding is ·027 ohm.

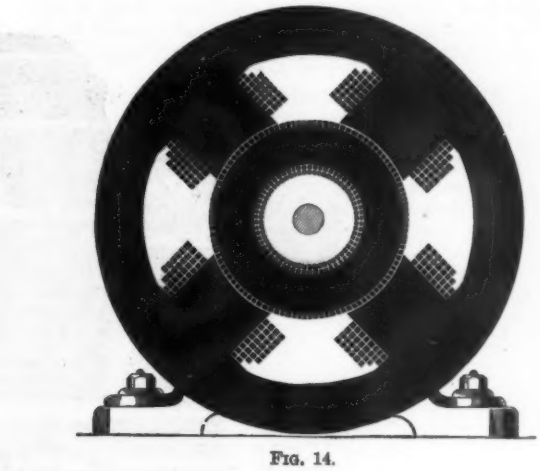


Fig. 14.

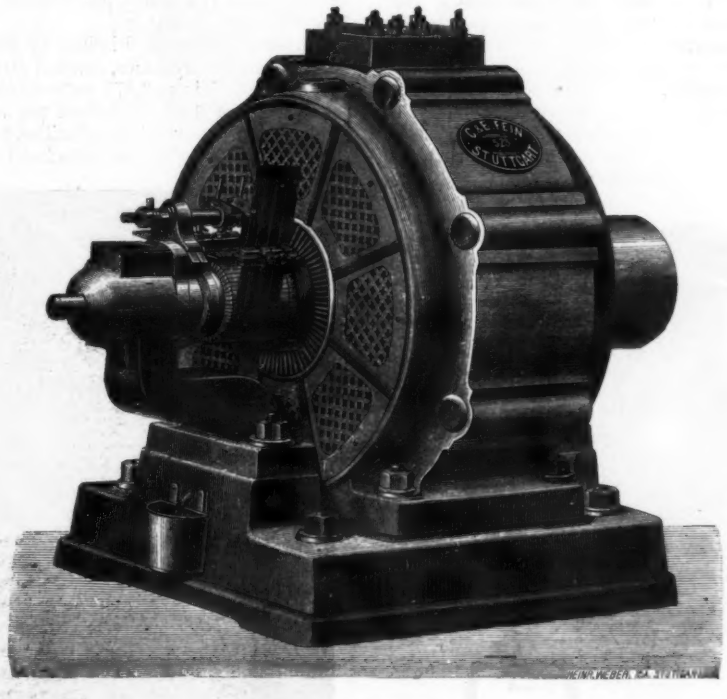


Fig. 13.

A comparison of these types serves to show how the weight

of the iron portion of the field system is reduced by increasing the number of poles. Suppose for a moment that the armatures in figs. 12 and 14 have the same diameter, then if the same proportion of the circumference is covered by the poles, the output at a given speed is the same for both types. Assuming that the induction is similar we get with four poles of half the angular width the same effect as with the original two. But the area of the poles being reduced, the section of the yoke and also that of the armature can be diminished in like proportion, so we get the iron parts lightened. On the other hand, there being four magnetising coils instead of two, the field copper in the special case we are considering, would be increased.

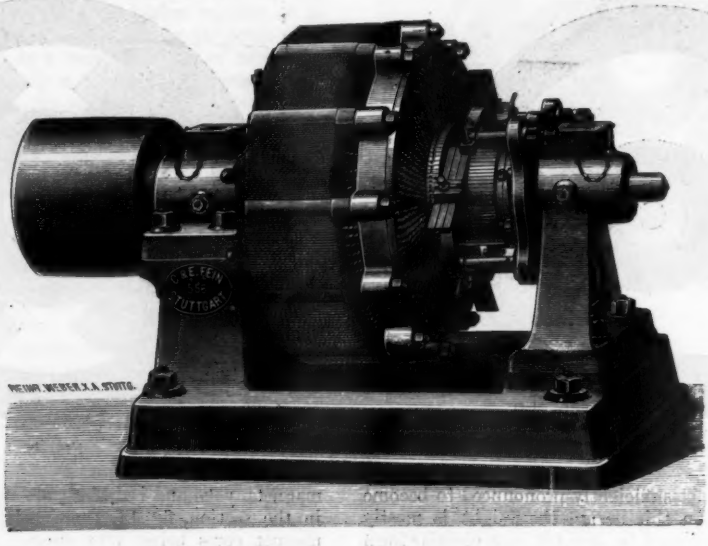


FIG. 15.

Messrs. Fein's interior pole machine is shown in perspective in fig. 15, and in section in fig. 16. At a speed of 520 revolutions per minute it gives 136 ampères by 110 volts, or, say, 15 kilowatts. The ring armature has a diameter of 50 cm. inside the winding, and 62·4 cm. outside the winding, its width being 16·5 cm. The core is built up of soft iron plates,

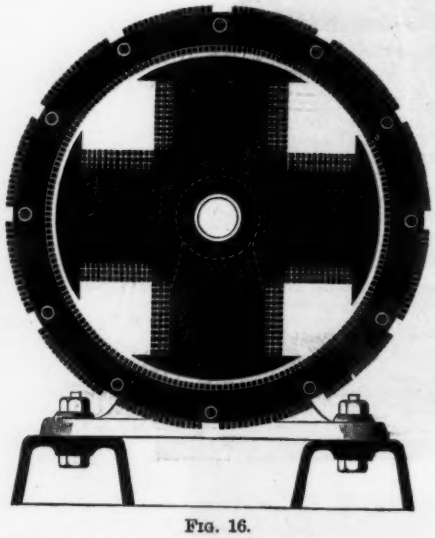


FIG. 16.

about 200 in number, separated from each other by paper and supported by 12 insulated bolts, securely attached to the star wheel keyed on the shaft. The armature winding is of square section copper, there being a single layer of 576 convolutions wound in 96 sections and connected to a corresponding number of commutator segments. The weight of copper is 17·5 kilogrammes, and the yield therefore 857 watts per kilogramme. The resistance warm is ·052 ohm. There are four magnets, as shown, cast in one piece, and provided with the necessary opening in the middle for the shaft to pass through. This casting is firmly attached to the bracket seen on the left hand of fig. 15. There are wound on each magnet 72 turns of series and 4,400 turns of shunt wire, the total weight being 70·9 kilogrammes. The resistance of the series coils connected in four parallels is ·023 ohm, while the shunt is 28 ohms. The amount of copper in the whole machine is 88·4 kilogrammes, while the total weight of the machine is 725 kilogrammes. The yield consequently comes out at 169 watts per kilo. of copper and 20·6 watts per kilo. total weight.

Messrs. Fritsche & Pischon of Berlin, show one of their wheel-armature dynamos, coupled direct to a horizontal steam engine, and giving 48,875 watts (425 ampères by 115 volts) at a speed of 140 revolutions per minute. This machine, which presents several peculiarities, has a cast-iron frame or shell, fig. 17, to which are attached two brackets for carrying

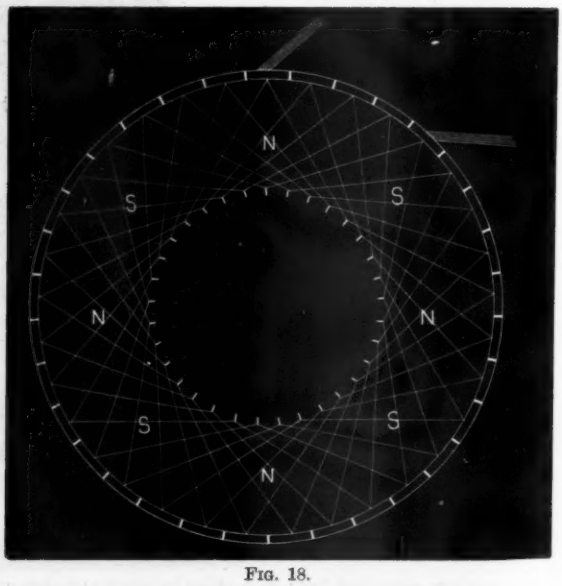


FIG. 18.

the bearings, and on each side a wrought iron ring to which are screwed the wrought iron field magnets. There are sixteen magnets, arranged in a circle of eight on each side of the armature. Poles on one side face poles on the other, of opposite sign, while around both circles they are arranged N. and S. alternately, The field, therefore, is not unlike that of a Siemens or Ferranti alternator. The armature is a wheel measuring 135 cm. in diameter, and constructed of 402

wrought iron spokes, 80 mm. wide by 5 mm. thick, through which flows the current. These spokes raked right and left, are held at their inner ends by a hub, while to their outer ends are secured short strips of bare copper insulated from each other, and having their ends wedge-shaped. The copper strips being firmly clinched at both ends by conical rings, lined with insulating material, they form the tyre of the wheel, and also a collector having 201 sections. The magnets are fitted with triangular pole shoes to suit the rake of the spokes.

The manner in which these wrought iron conductors are arranged will be made clear by the explanatory diagram given in fig. 18, though for simplicity, 33 collector segments and 66 spokes only are here shown. The poles are eight in number, and are situated where the letters, N. and S., are marked, two brushes at 45° angular distance apart being employed to collect the current. The winding is, of course, continuous, and if carefully followed, it will be found that one-half the spokes in series conspire to produce an E.M.F. in a direction opposed to that of the E.M.F. produced by the other half, so the brushes being placed where the opposing E.M.Fs. meet, if one might so put it, collect a current flowing through the armature in two parallels.

Returning to the machine under description, it will be seen that, the conductors being of iron, the magnetic resistance of the air gap is much less than if copper of the same width were employed. Naturally, there occurs to one the idea that if copper were used the width would require to be only one-sixth that of the iron; but should the idea take the form of a criticism, the makers might promptly reply that iron was required at any rate to give the stiffness necessary, either in the form of a separate core or in the form it takes in their machine, where it has to serve the dual purpose of core and conductor. There is no covering on the spokes, and only incombustible material is used for insulation at the hub and collector. The brushes are capable of adjustment by a hand-wheel, both brush pins being attached to a movable slider, shown on the top of the machine. The lubrication of the bearings is effected by means of two metal collars threaded on each journal, which are bored somewhat larger than the journal, and dipping into an oil well, cause a continuous flow of oil. The machines appear to have been well thought out and are very well liked on the Continent.

At the exhibit of Gebr. Körting, a Fritsche machine may be observed directly coupled to a Körting gas engine, making 150 revolutions per minute, the combination striking one as rather novel.

(To be continued.)

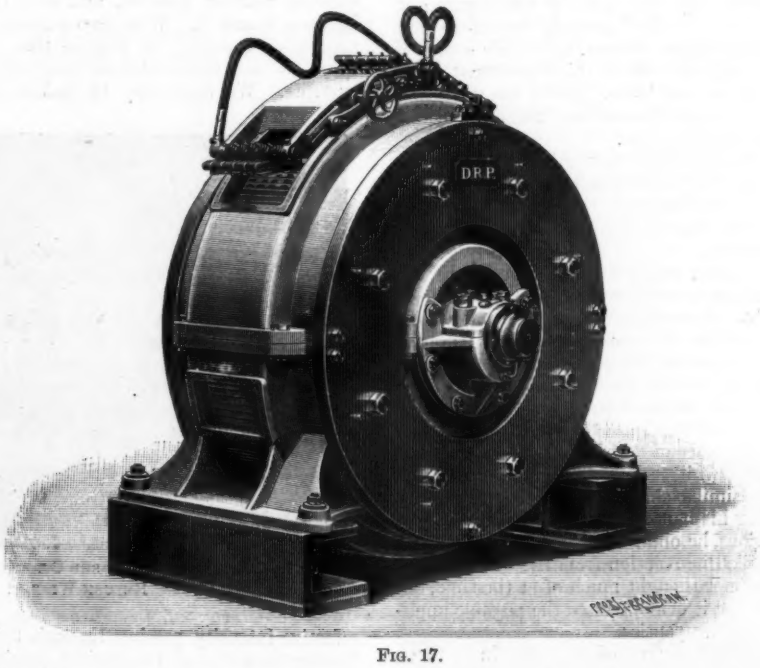


Fig. 17.

THE ELECTROLYSIS OF ORGANISED SUBSTANCES.

The applications of electrolysis are every day becoming more numerous and important, not merely in the domains of pure physics and chemistry, but in the great industries. And this is not a matter for wonder, for some of the leading scientists of the last few generations have given their attention to the development of electro-chemistry; such names as Davy, Faraday, Jacobi, de la Rive, Elkington, Ruolz, Morissan, &c., at once suggest the work with which they have been identified.

The remarkable facility with which electrolysis lends itself to all sorts of widely different applications, doubtless explains its present success and increasing importance. And then, again, it happens that the conditions and results of laboratory experiments in electrolysis are directly comparable with those of the same operations on an extensive industrial scale, and hence the whole system of a new process may frequently be worked out without much expenditure.

One of the most interesting adaptations of electrolysis is that in which organic substances and organised matters of animal or vegetable nature are dealt with. In this branch of research there appears to be endless room for experiment, and it is one which, up to the present, has not been very much exploited, possibly on account of the complex nature of most organised substances, and the complex phenomena with which their electrolysis is accompanied.

One of the earliest experiments upon organised substances was made by Davy, who passed the current from a powerful battery through a laurel leaf, under such conditions that the active chemical principles of the leaf were separated; at the positive pole hydrocyanic acid was liberated, whilst at the negative pole a mixture of several substances of obscure composition was eliminated, amongst them being a trace of lime.

In this instance we see an example of a common rule which governs the deposition of the acid at the positive pole and that of the base at the negative pole.

A similar result is seen in the electrolysis of a leaf of mint; an acid being set free at the positive pole and the bases being formed at the negative pole.

Again, the electrolysis of a solution of opium gives meconic acid at the positive pole and morphine, an alkaloid base, at the negative pole.

Examples might be multiplied to show that the behaviour of organic substances under electrolysis follows the same law

as do the inorganic substances, but in the case of organised substances, as distinct from organic matters, there are often complicated and varied secondary reactions.

We will consider another case of the electrolysis of organic matters.

If an electric current be passed into a vessel containing absolute alcohol or ether, these liquids are not decomposed by it; absolute alcohol, like absolutely pure water, conducts electricity very badly. By employing very energetic currents it is possible to decompose the trace of water which the purest of alcohols usually contains, the oxygen being carried to the positive pole, when it gives rise by combination to other products.

Theoretical reasoning suggests that it ought to be possible to decompose absolute alcohol, and by adding a little potash to increase the conductivity. Connel has succeeded in effecting the decomposition of both methyl and ethyl alcohol, hydrogen being disengaged at the positive pole, carbonate of potassium at the negative, whilst the liquid is reddened by the liberation of a resinous matter.

Such observations as these have up to the present received but rarely any application of an industrial nature, but there have been several attempts of a more or less successful character to improve spirits by means of electrolysis. Perhaps the efforts of MM. Laurent, Naudin in this direction are the best known. Ordinary alcohol, we know, is rarely pure; it ought to consist entirely of ethyl alcohol, but there are usually some higher homologues present, and these confer a bad taste. This is notably the case in spirit produced from grain, beetroot, or potatoes, and Mons. Naudin has succeeded in adapting electrolysis to the elimination of these impurities at a cost which is comparatively low.

The action of the electric current upon animal substances is curious; it is at present of special interest, owing to the recent communication of Dr. Foveau de Courmelles to the Paris Academy of Science, concerning what he calls the electric absorption of medicaments.

The law of decomposition, which we have seen to be the same for vegetable matters as for inorganic substances, holds also for animal matters. For example, if a piece of muscle be submitted to the action of a current from a powerful battery for a sufficient length of time, decomposition sets in; acid matters are carried to the positive pole, whilst basic matters are liberated at the negative pole. If this action be sufficiently prolonged it will eliminate the whole of the saline matters contained in the piece of flesh.

Davy showed a long while ago that living matter was capable of undergoing similar changes under the influence of electricity. By placing his hands in two vessels, under properly governed conditions, he obtained an acrid reaction from one of them, and an alkaline reaction from the other.

This experiment was not thought much of at the time, but it was very important, for it demonstrated the possible application of electrolysis to therapeutics.

Electrolysis can effect a transport of elements in a much more complicated way than many suppose. Thus, suppose we take three vessels containing water coloured with syrup of violets, and connect them with threads of cotton moistened with the same liquid; then into the first vessel dissolve a small quantity of some neutral alkaline salt. On passing the current colour changes will take place, the liquid turns green at the negative electrode, red at the positive electrode, whilst the contents of the centre vessel are violet.

The property of electrolysis may obviously be used for extracting or introducing substances into animal or vegetable tissue, and in therapeutics, MM. Vergnes and Poey have developed a mode of treatment based upon the kind of reaction which we have just illustrated. Thus metallic matters, which may have been introduced into the system by cutaneous absorption, or by the alimentary or respiratory passages, can be eliminated by placing the patient in a bath containing a conducting liquid—a solution of salt, for example, and passing a current. A convenient arrangement makes the walls of the bath serve as a negative electrode, whilst the patient holds the positive electrode in his hands.

The inverse case, namely, the introduction of matters into the system by electrolysis, is more difficult to realise; but success has been attained in certain special cases. For example, the absorption of iodine from a solution of potassium iodine has been successfully accomplished.

Mons. Berthier, to whom we are indebted for some of the above facts, states that there are reliable statistics collected now in France showing that in cases of neuralgia, rheumatism, paralysis and other troubles of the nervous system, the employment of electrolysis for absorption or elimination may be attended with very beneficial results. But let it be understood this kind of treament, which the French term *l'électrolyse médicamenteuse*, is in no way analogous to those quack systems of so-called "medical electricity" which we have sometimes exposed in these columns.

POLYPHASED ALTERNATE CURRENTS.

(Continued from page 419.)

GENERATORS.

BEFORE entering upon the description of polyphased alternate current generators, the first question that suggests itself relates to the choice of the number of currents to be used, when once we have admitted the necessity of having recourse to these multiple currents on account of their special properties.

In order not to increase indefinitely the number of wires, it is evident that we should limit ourselves practically to the smallest number possible, and that thus our decision lies between 2 and 3. With two currents having a lag of a quarter of a period, we require four wires, or, at any rate, three, if one serves as a common return wire for the two currents. We have only to look at fig. 1 to see that the

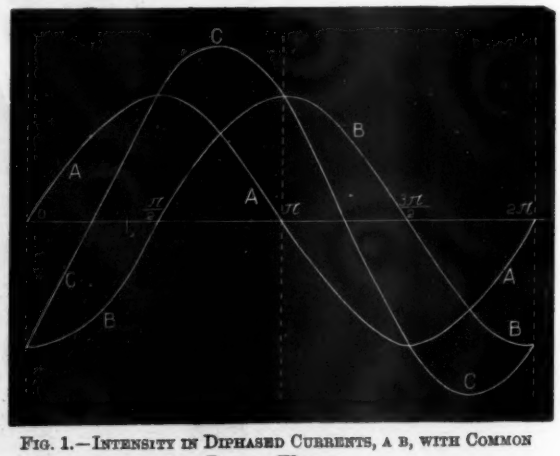


FIG. 1.—INTENSITY IN DIPHASED CURRENTS, A B, WITH COMMON RETURN WIRE, C.

effective intensity passing through this common wire, C, is greater than that of the current passing through the other wires, A and B; we must, therefore, give it a greater section which destroys symmetry. With three currents lagging by a third of a period, however, fig. 3 shows that the effective

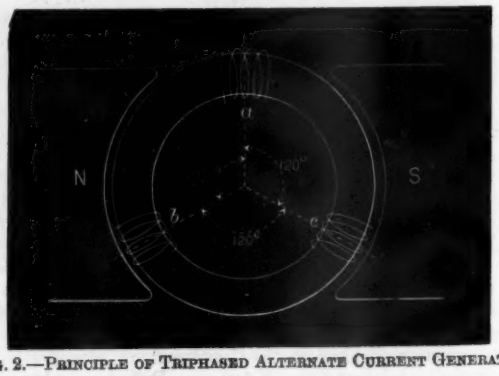


FIG. 2.—PRINCIPLE OF TRIPHASED ALTERNATE CURRENT GENERATOR

intensities are the same, and that their algebraic sum is *nil* at each moment. Thus there is symmetry, and consequently equality of section in the three conductors.

We will, therefore, commence our subject with an exami-

nation of triphased currents with three conductors of equal section.

Generators.—We will imagine, for the sake of illustration, a Gramme ring (fig. 2), changing its position in a simple magnetic field, three elementary bobbins, *a*, *b*, *c*, being attached to this ring at 120° from one another. If we turn the armature these bobbins will become the seat of alternating electromotive forces which we will suppose to be strictly sinusoidal, which form, indeed, they assume, with very little variation, in practice. Fig 3. shows the value of

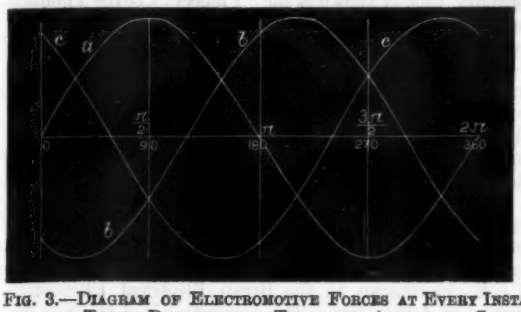
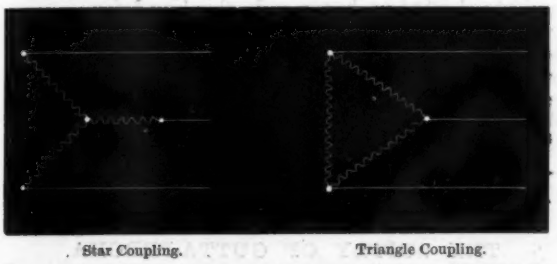


Fig. 3.—Diagram of Electromotive Forces at Every Instant in the Three Bobbins of a Triphased Alternate Current Generator.

these electromotive forces at each instant. These three bobbins may be connected with three outer wires in two different ways; in a *star* or in a *triangle* (fig. 4). The *star* connection is termed by M. Dolivo Dobrowolsky *open circuit connection*, and the *triangle* connection *closed circuit connection*. The expressions "star" and "triangle" seem, however, better suited to the case.



Star Coupling. Triangle Coupling.

Fig. 4.—Coupling of Triphased Alternate Current Generators.

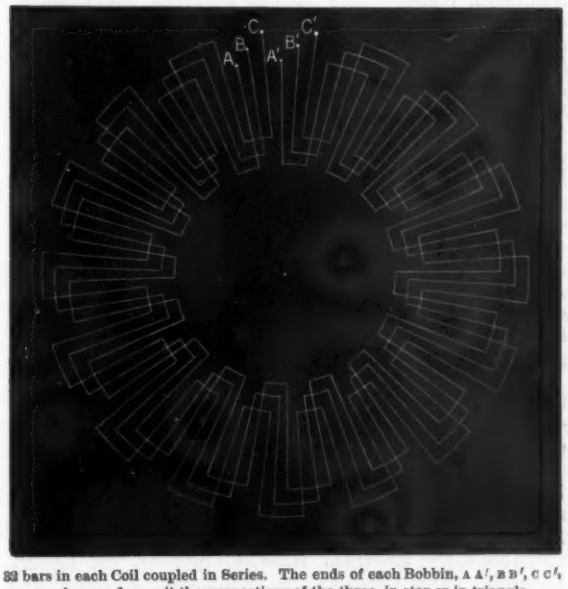
However this may be, either of these modes of coupling gives, in the outer circuits, three lagging currents, but the "star" mode has a certain advantage over the "triangle," in that it is possible to connect the common centre of the three circuits with a fourth or neutral wire, and to establish apparatus working as simple resistances, incandescence lamps, for instance, between the neutral wire and each of the three other wires; the corresponding bobbin of the generator then acts as an ordinary alternating current dynamo without either reacting or disturbing the working of the system, but the triangle mode of connection does not allow of this arrangement.

In the foregoing illustration, we have supposed the generator to consist of a Gramme ring and three elementary bobbins, each occupying but a very small fraction of the circumference. Practically, we can very easily realise an alternator with triphased currents with an ordinary Gramme machine, by connecting three points 120° apart in the continuous winding with three insulated collecting rings, on which rest three brushes which are themselves connected with the outer conductors. We thus obtain a generator, the three bobbins of which are connected in a triangle. The inductors may be excited separately, or, which is often more convenient, be fed by a derivation taken on the collector, the machine thus producing at the same time continuous current and triphased current. (We will further discuss the properties of an apparatus thus constituted.)

But if we study a little more closely the electromotive forces developed at each moment in each third of the ring, we can see that they are not always utilised under the best possible conditions, and that thus we only obtain the algebraic sum of these electromotive forces, certain spirals tending to produce a current of one direction, and the others a current in an opposite direction. Thus, in practice, this arrangement has been given up, for it has the obvious disadvantage of increasing the internal resistance of the generator, and of reducing its specific power* and its efficiency. The drum winding has been preferred for the construction of large machines producing triphased alternate currents.

By connecting together in a suitable manner the induced bars which arrive at each moment at the same relative position with regard to the inductors, we get a generator in which there are never, in any of the circuits, two opposite electromotive forces. Moreover, polyphased current dynamos being always machines of great power, and turning at a low angular speed, multipolar inductors should be employed. In Brown's generator at Lauffen, which may be taken as a type of a carefully studied machine, there are 32 poles and 96 induced bars, so that between two consecutive poles there are only three induced bars corresponding to each of the three circuits. As regards frequency, there does not seem to have been any attempt made to attain, with polyphased currents, the high frequencies attained with ordinary alternating currents (133 periods per second is the Westinghouse system). In fact, the number of periods is comprised between 30 and 40 per second. These low frequencies reduce the specific power of the generator, transformers and motors, but they allow of higher efficiencies being given by the motors, and this compensates, and more than compensates, for the reduction of specific power. The frequency would even be still lower, if it were not for the fear that this would involve periodic variations of luminous intensity which would affect the incandescence lamps and, still more, the arc lamps.

All the polyphased alternate current generators are low tension machines. The general opinion at present is, that it is better, when it is required to transport energy to a great distance, to construct machines of low electromotive force, strong, simple, easily constructed and insulated, and to transform these currents of low tension in a suitable apparatus. We thus gain increased security by confining the high tensions to transformers which are inert and can be easily insulated, and which are rarely touched. Notwithstanding the employment of an intermediate apparatus, it is more economical to construct a low tension machine and a transformer than to construct a dynamo giving directly the high tension required for transport to a great distance. The idea of producing low tensions and transforming them at the starting point, has been proposed several times for ordinary alternating currents, with a view to avoiding the dangers and the



32 bars in each Coil coupled in Series. The ends of each Bobbin, A A', B B', C C', are free, and permit the connections of the three, in star or in triangle.

Fig. 5.—Winding of Brown's Triphased Alternator at Lauffen.

difficulties of construction of high tension machines; but we do not think it has ever been practically applied before the Lauffen-Frankfort experiments.

On account of the enormous intensities of the currents

* The specific power of a machine is the quotient of its power by its mass, and is measured in watts per kilogramme, or in watts per pound

produced by the low tension dynamos, the armatures are naturally left fixed, which facilitates the connections, and the inductors are made to revolve by supplying them with the exciting current by means of brushes and collecting rings communicating with the winding of the inductors.

The generating dynamo of Lauffen, a full description of which appeared in the ELECTRICAL REVIEW of August 28th, fulfils all the conditions that we have mentioned and constitutes the most perfect type of generator of triphased alternate currents that we can mention. To complete this description, to which we refer our readers, we append diagrams (fig. 5) showing the winding of the 96 induced bars in three circuits, each containing 32 bars in series.

In order to facilitate the reading of the connections, we have substituted for the cylindrical winding sectional a tronconical winding, and we have placed the three series of connectors arranged at the two ends of the winding on circles of different diameters in order to avoid their superposition. The three windings give six free ends, which can be connected at will in a triangle or in a star, according to the applications intended.

Before quitting the question of triphased generators, or *triphasers*, we wish to call the attention of professors desirous of showing their pupils the properties of these currents to a means of obtaining them without having a special machine constructed and without even adding collecting rings and connections to an ordinary Gramme machine.

We have only to take an alternating current Gramme machine of the type known as *self-exciting*, with multipolar inductors, and to establish suitable connections between the fixed elementary bobbins constituting the induced winding. The natural lagging of these bobbins resulting from the construction itself supplies us at once with polyphased currents capable of being used for the demonstration and repetition of the principal experiments, allied to the polyphased alternate currents.

E. H.

ELECTRICITY IN NEW SOUTH WALES.

[FROM A CORRESPONDENT.]

TUESDAY, September 8th, saw a large gathering of electrical engineers at the inaugural dinner of the "Electric Club of New South Wales." The want of a club, or association of some kind where men interested in electrical engineering might meet each other and talk over matters, has long been felt, and several attempts have been made to form such an institution. The ranks of the electrical profession in New South Wales have been materially increased lately by men from home and America, and it was thought that now was a good time to formulate a scheme. Mr. Jas. O. Callender, Mr. Oswald Haes, of the Brush Electrical Engineering Company, and Mr. Arthur C. F. Webb, of the telegraph department, formed themselves into a provisional committee to deal with the matter, and the support given has satisfied them that the step taken was well advised. The dinner was arranged for at the Australia Hotel, and about 70 invitations sent out. Of these 70 invitations, 50 odd accepted, and letters of sympathy with the movement received from several gentlemen who were unable to be in town on the occasion.

The chair was taken by Colonel E. C. Cracknell, superintendent of telegraphs, and among those present were representatives of all the electrical engineering firms of Sydney, including the Brush Electrical Engineering Company, the Crompton Electric Supply Company of Australasia, Messrs. H. H. Kingsbury & Co., New South Wales representative of the Thomson-Houston and Western Electric Companies, Messrs. Woodhouse and Rawson, Messrs. Westcott, Marshall and Adams, the Electrical Material Company, the Eastern Extension Cable Company, the Williamson Electrical and Engineering Company, the Callender Bitumen Company, Messrs. Wood Brothers, Messrs. Frost and Shipham; there were also present Prof. Threlfall, of the Sydney University; the president, vice-president, and honorary secretary of the Engineering Association; Mr. A. J. Arnot, electrician to the City of Melbourne; Mr. W. H. Masters, of Melbourne; Mr. P. B. Elwell, of the Railway Electrical Department; Prof. Salmon, of the Technical College, and several representatives of the Telegraph Department.

The objects of the club were explained as being "For promoting social intercourse amongst members of the electrical profession of New South Wales and advancing the interests of electrical engineering generally, and to enable the members of the club to take concerted action, if necessary, on matters of general importance."

It is proposed to hold social, scientific and commercial meetings, &c. A committee was formed consisting as follows:—President, Colonel E. C. Cracknell, M.I.C.E., M.I.E.E., Superintendent of Telegraphs; Vice-Presidents, Mr. H. H. Kingsbury (usually known as the "Pioneer"), of the Thomson-Houston and Western Electric Companies, and Capt. F. C. Rowan (known as "The Skipper"), Managing Director of the Brush Electrical Engineering Company of Australasia; Honorary Treasurer, Mr. Jas. O. Callender, of the Callender Bitumen Company; Honorary Secretary, Mr. Arthur C. F. Webb, A.I.E.E., of the Telegraph Department; Members of Committee: Mr. G. D. Hamilton, Manager of the Electrical Material Company; Mr. P. B. Elwell, Electrical Engineer to the Railway Department; Mr. A. H. Whiffen, Managing Director of the Crompton Electric Supply Company of Australasia; Mr. Robert Oxlade, A.I.E.E., of the Williamson Electrical and Engineering Company; and Mr. Oswald Haes, M.I.E.E., electrician to the Brush Electrical Engineering Company of Australasia. The committee is, I think, a very representative one, and should be a good working committee. It may be noticed by those of your readers who may be members of the Finsbury Technical College Old Students' Association, that Mr. Haes and Mr. Webb both occupy the same positions as they filled on the original committee of that Association. As a proof of the need of such an organization, it may be said that much surprise was expressed that there were so many men in Sydney interested in electrical engineering, and introductions were many and often amongst men who should have known each other long before.

It has been suggested that the club, instead of standing on its own basis, should form a branch of either the Engineering Association or the Royal Society, but the general opinion seems to be that electrical engineers in New South Wales are now strong enough to stand alone, and it would certainly appear so from the support already given.

THE SUPPLY OF GUTTA-PERCHA.

THE increasing scarcity and cost of gutta-percha of good quality, due to the large demand of the present day, is a fact of so much importance, that any prospect of increasing the supply must be hailed with satisfaction by all users of the gum; and it is therefore interesting to know that according to M. Sérullas, the *isonandra gutta* still exists in the island of Singapore, where for over 30 years it has been supposed to be extinct.

This re-discovery of the gutta-percha tree at Singapore is, however, hardly likely to benefit the users of the gum unless some less wasteful method of collecting it can be introduced, as the destruction of the trees by the native collectors goes on at such a rate that the Malay forests, from which our supply is now obtained, are each year growing smaller and smaller, and will, it is feared, be entirely destroyed in the course of a few years. As regards the method of collecting the gum, some interesting information is given in the current number of the *Kew Bulletin*, in which is published some correspondence giving an account of a process recently invented by M. Sérullas for extracting the gum from the twigs and leaves of the gutta-percha tree, and also of the earlier attempts made at the suggestion of Mr. Leonard Wray to extract the gum from the bark of the tree.

In a report made in 1883, Mr. Wray, after describing the method of collecting employed by the natives, says that the amount of the gum obtained from a single tree appears to have been greatly over-estimated, and as bearing out this statement, he quotes the yield, which was only 2 lbs. 5 ozs., obtained by him from a tree 2 feet in diameter (measured 6 feet above the ground), about 100 feet high, and judging from the annular rings over 100 years old. When we consider that the annual export from the Straits Settlements is said to be about 10 million pounds, the only wonder is that there is still such a thing left as the gutta-

percha tree. Owing to the smallness of the yield obtained by him, Mr. Wray was led to make some experiments to determine what proportion of the total amount of gutta contained in a tree was obtained by the usual native methods, and how much was left in the bark; and for this purpose he had a tree felled, and scores cut in the bark at distances of 15 inches along the whole length of the trunk, from which he collected the gutta. He then removed some of the bark, pounded up a weighed sample in a mortar, and boiled it in water, when the gutta formed itself into small white flakes, which were collected into a mass by stirring, and purified by boiling in clean water. When weighed it was found that the yield of clean gutta-percha was equal to 5·3 per cent. of the weight of the sample of bark, or if the bark was first dried, which reduced its weight by about 50 per cent., the yield of gutta was over 10 per cent. By calculating the weight of bark on the trunk of the tree, Mr. Wray estimated the total weight of the gum contained in it, and found that, in this instance, it was 37 times the weight of the gutta obtained by the usual method of collecting.

Seeing the immense saving of trees which would result, if the gum could be successfully extracted from the bark, Mr. Wray sent over a quantity of dried bark to Kew, with a request that a report might be obtained as to the yield of gutta, and its commercial value when obtained in this manner. This bark was sent to the Silvertown Company, who reported that they had obtained 13·6 per cent. of gutta and resin from it, but that the large amount of resin present made the product commercially valueless.

The process proposed by M. Sérullas does not necessitate the felling of the tree, but merely a pruning off of the twigs and leaves, and therefore it will, if successful, stop the wholesale destruction of the forests. The treatment is described as follows: The twigs and leaves are finely chopped up, and are then treated with acid (which is the main secret of the invention) until a reddish brown liquor is produced. This is put into an alembic, already supplied with a small quantity of water, to prevent the gutta from sticking to the sides of the vessel, and steam is applied for about 20 minutes or half-an-hour, during which the acid evaporates, and is drawn off. It is stated that about 2 per cent. at least of pure gutta should be obtained from the raw material, and that a syndicate has been formed at Singapore to work out the process, and to establish a factory.

It is possible that, by acting upon fresh material, instead of dried bark, the gutta may be obtained in good condition; but even if more successful than the plan proposed by Mr. Wray, there still remains the difficulty of transport through the forest, and in this matter the increased weight of the raw material will tell very heavily against the process, unless plantations can be obtained in convenient positions to which access can be given by good roads.

CLOSE OF THE FRANKFORT EXHIBITION.

[FROM A CORRESPONDENT.]

The formal proceedings which brought to a close the International Electrical Exhibition at Frankfort-on-the-Maine on Monday evening, were preceded on Saturday evening by some remarkable experiments carried out by Messrs. Siemens and Halske, of Berlin. The practical success of the Lauffen-Frankfort plant, with a transmission of 20,000 volts, had induced the firm in question to determine whether it was not possible to excel both the General Electricity Company, of Berlin, and the Engineering Works, of Oerlikon, in the matter of running lamps indirectly, of course, from mains carrying current at a higher pressure than in the case of the Lauffen plant. Arrangements were accordingly made, and a select party was invited on Saturday evening to witness the experiments.

Two transformers in oil were used, with the secondary coils in series, for the purpose of getting current at 40,000 volts! This pressure was obtained, as was also in one test the exceedingly high potential of 48,000 volts, and after experiments had been made as to the safety and general effects of the current, the latter was caused to illuminate 400 glow lamps, the primary current passing along a Siemens cable being at 40,000 volts. Of course, everybody present was pleased with the results, more so those who had nothing directly to do with the tests. At the same time, the experiments will be regarded as a sign of what may be expected in the future applications of electricity.

ELECTRIC LIGHTING REPORT TO THE GRAYS LOCAL BOARD.

At the Grays Local Board, on Thursday last week, Messrs. A. W. Boatman and J. Golden, who had been appointed by the board to consider the question of lighting the streets under their control by the electric light, submitted to "The Grays Thurrock Local Board" a report.

The report states, that in order to ascertain the conditions under which similar neighbouring towns were lighted, we directed the clerk to communicate with their authorities, and from the replies we find that (with the exception of Southend) the lamps are lighted from sunset to sunrise on the following terms:—

1. Gravesend.—£2 5s. 6d. per lamp, the corporation lighting, extinguishing and cleaning.

2. Northfleet.—£3 3s. 6d. per lamp, the gas company lighting, extinguishing and cleaning.

3. Romford.—A portion of the lamps are lighted for ten months all night (except seven nights at each full moon, when they are not lighted), for which £3 6s. per lamp is paid; the company lighting, extinguishing, cleaning and repairing; the other portions are alight all night all the year round, at £4 per lamp.

4. Southend.—£2 0s. 6d. per lamp; the lamps being extinguished at 11 p.m. from November to June, and at 11.30 from July to October.

Your committee would also point out the advisability of having the public lighting under the entire control of the Local Board, and as the directors of the gas company assured them that there was no profit arising to the company from the present supply, your committee would suggest that as the board are about to erect a pumping station for the sewerage works, whether it would be possible to construct the machinery so that the town might be lighted by electricity. From enquiries they have made, they are of opinion this is a matter worthy the consideration of the board.

After some discussion, it was decided to defer the consideration of the report until the next meeting, in the meantime to send a copy of it to the gas company.

LONDON COUNTY COUNCIL.

The following reports were submitted by the various committees at the last meeting:—

Electric Light for the Offices.

The council has from time to time given authority for the installation of the electric light in some of the rooms of the main building. We have now to report that we have had under consideration the desirability of extending the light throughout the whole of the offices. We have had a report from the council's medical officer of health on the injurious effects of gas, and the advantage that would be derived by the adoption of the electric light. He states that the amount of air required to dilute the carbonic acid resulting from an ordinary gas burner is more than double the amount of air required to dilute the carbonic acid given off by a human adult. The necessary cubic space required for purposes of health in any room is therefore vastly greater when gas is used. In the opinion of the medical officer, the use of the electric light is attended with no disadvantage connected with health. The medical officer of the Post Office, in writing to him on the results attending the use of the electric light in that department, gives a very favourable opinion. He states that "the fact that a much better light is given without the evils attendant on the use of coal gas, namely, the abstraction of oxygen, the production of the results of its combustion, and also, no mean consideration, the generation of great heat, must commend its use to everyone." He further states "that the officials in the Post Office have expressed themselves to be feeling much better in health, and better able to perform their duties since the adoption of the electric light." The council's medical officer also informs us that Mr. Brudenell Carter has had exceptional opportunity of studying the effect of electric lighting on the eyes, through having under his observation all cases of impairment or defect of sight among the persons employed in the offices of a large London industrial establishment. After several years' experience of the electric light in this establishment, Mr. Carter states that no prejudicial results have attended its use. The chief engineer estimates the cost of the work at £1,500, and in his report adds that, as there is nothing in the light to blacken ceilings and walls, the adoption of the electric light would probably lead to a saving in the present somewhat heavy expenditure for annual cleaning. There is also far less danger from fire if the work is well done and properly looked after. The offices, as the council is aware, are crowded, and in view of the medical officer's report, we are of opinion that the evil effects likely to be caused to health by this crowding might, in a measure, be remedied by the adoption of the electric light. We accordingly recommend that, subject to an estimate being submitted to the council by the Finance Committee, as required by the statute, the electric light be extended throughout the main building

of the offices of the council, and that we be authorised to obtain tenders for the work.

TELEPHONIC COMMUNICATION.

The chief engineer has pointed out that it would be convenient if the premises, No. 31, Spring Gardens, where a portion of his staff is located, were placed in telephonic communication with the main building. The cost would be about £10 per annum. We recommend that authority be given for the premises, No. 31, Spring Gardens, to be placed in telephonic communication with the main building, at a rent not exceeding £10 a year, and that the solicitor be instructed to prepare a three years' agreement with the National Telephone Company for the purpose.

REPORT OF THE PARLIAMENTARY COMMITTEE.—SUBWAYS.

We are proceeding on the resolution passed by the council on June 9th last, referring it to us to prepare a Bill giving the council power to require that where there are subways in any thoroughfare, gas, water and other companies shall lay their pipes, wires, &c., in such subways, and shall pay to the council a rent in respect of the user of the subways; such rent to be agreed upon, or, in case of difference, settled by arbitration of the Board of Trade. The council will no doubt recollect the proceedings on the Bill dealing with subways introduced in 1890, and the essential difficulties of the subject. As the proposed Bill will affect all the gas, water, electric lighting, telephone and other like companies, it will no doubt meet with opposition, and being a special subject should, the Parliamentary agent considers, be dealt with by a separate Bill. We concur in this view, and have accordingly instructed the agent to proceed with the preparation of such a Bill.

NOTICES UNDER ELECTRIC LIGHTING ORDERS AND ACTS.

We have considered a notice, dated September 28th, 1891, from the Electric Installation and Maintenance Company, of intention to lay mains from Springfield Wells Road, Sydenham, along Springfield, to and along Wells Road to its junction with, and along, Sydenham Hill, to the north end of the Crystal Palace. This, the first notice under the Crystal Palace and District Electric Lighting Order, 1890, is for a line of high tension mains from the Springfield generating station to the Crystal Palace. It is intended to use lead-covered cable, laid in stoneware pipes, surrounded with concrete when laid in the carriageway but uncovered when under the footways, and the street boxes are shown as with single covers of iron. We are of opinion that the proposed works may be approved, subject to the conditions stated below; and we recommend that the sanction of the council be given to the works referred to in the notice dated September 28th, 1891, of the Electric Installation and Maintenance Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works; that the pipes be laid at such a depth that the top of them shall be at least 2 feet below the surface of the ground; that the pipes be laid under the footways wherever it is found practicable to do so; that the pipes, where laid under the footways at a less distance than 6 inches from the kerb, or under the carriageway, shall be surrounded with concrete; that provision shall be made for preventing accumulation of gas in the street boxes; that for the top course of brickwork in the boxes, as shown on the plan, 3-inch York-stone shall be substituted; that, as an additional precaution against accident through defective insulation of the mains, each of the street boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable; and that the outer cover, which shall consist of an iron frame filled in with material to suit the paving, shall be efficiently connected to earth.

A notice, dated October 2nd, 1891, has been received from the St. James and Pall Mall Electric Light Company, of intention to lay mains across Pall Mall at John Street and Waterloo Place. These works are of the usual character, and there seems to be no objection to them. We recommend that the sanction of the council be given to the works referred to in the notice, dated October 2nd, 1891, of the St. James and Pall Mall Electric Light Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works.

The Notting Hill Electric Lighting Company has given a notice, dated October 7th, 1891, of intention to lay mains along a part of the north side of High Street, Notting Hill; line to No. 39, Linden Gardens; and lines to No. 24, Dawson Place, No. 6, Pembridge Villas, and to the Convent of Zion, Chepstow Villas West. The proposed works are unobjectionable: and we recommend that the sanction of the council be given to the works referred to in the notice of the Notting Hill Electric Lighting Company, dated October 7th, 1891, upon condition that the company do give two days' notice to the council's chief engineer before commencing the work; that the cover stones of the culverts under 20 inches wide shall be not less than 2 inches thick, and of the wider culverts not less than 2½ inches; and that where the culvert crosses the carriageway there shall be at least 9 inches thickness of Portland cement concrete above the cover stones of the culvert in addition to the road material.

We have also considered a notice, dated October 14th, 1891, with one plan, from the House-to-House Electric Light Supply Company, of intention to lay mains in Queen's Gate (part of) and Mason Place (part of). These works are of the usual character, and we recommend that the sanction of the council be given to the works referred to in the notice dated October 14th, 1891, of the House-to-House Electric Light Supply Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the work; that no pipes of a larger diameter than 6 inches shall be used; that the street boxes to be used shall be of the pattern approved by the council; and that as an additional precaution against accident through defective insulation of the mains, each of the street boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable, and that the outer cover shall be efficiently connected with earth.

We have also to report the receipt of the following notices, given in accordance with the resolution of the council to accept four days' (instead of one month's) notice in respect of the laying of service lines from mains already laid:—From the St. James and Pall Mall Electric Lighting Company—October 2nd, 1891—To 90 and 192, Regent Street, 10, St. James's Square, 3, St. James's Street, and 13, Burlington Street; October 5th, 1891—To 99 and 143, Regent Street, and 200, Piccadilly; October 12th, 1891—To 98, Regent Street, 2, Vigo Street, and 28, Old Burlington Street; October 15th, 1891—To 220, Regent Street. From the Electricity Supply Corporation—October 6th, 1891—To Craven House, Northumberland Avenue; October 15th, 1891—To Messrs. Haxell's premises, Exeter Street. From the London Electric Supply Corporation—October 8th, 1891—To the Doré Gallery, New Bond Street, and 21, Haymarket. From the Westminster Electric Supply Corporation—October 5th, 1891—To 40, Wilton Road.

LIGHTING OF WEIGHTS AND MEASURES OFFICES.

We have to report that, acting on the authority of the council of July 28th, we have accepted the tender of Messrs Drake and Gorham for the provision of electric lighting at the Newington permanent weights and measures office. The tenders we received for this work were as follows:—

	£	s.	d.
Messrs. Drake and Gorham	143	0	0
Brush Electrical Engineering Company ...	150	0	0
Messrs. Crompton	182	17	10

NOTES.

The Action of Heat on the Gradual Combustion of Electrolytic Gas.—A. Krause and V. Meyer have recently been studying the action of heat on the gradual combustion of gaseous mixtures, with the view of ascertaining whether such mixtures as ordinary electrolytic gas, when heated to a temperature below the ignition temperature of the mixture, show similar regularities in the relation of the time of heating to the quantity of water formed by the combination of the gases, as is observed in the case of hydrogen and chlorine when exposed to light. Very small quantities of air, if present with the mixture of electrolytic gases, exercise so much influence on the combination of the gases when heated that it was found impossible to work out the above relationship without the gases being in a state of perfect purity. The results of experiments made under varying conditions with most carefully purified electrolytic gas fail to show any relationship between the time during which the mixture is heated and the quantity of water formed; but further experiments are being conducted, the results of which will probably be published in the *Annalen*.

The Preparation of the "Alumina-Carbon" used in Obtaining Aluminium.—In the manufacture of aluminium and aluminium chloride by certain electrical methods an intimate mixture of carbon and alumina is made use of, which is commonly called "alumina-carbon." Details of the manufacture of this substance are given in the *Chemiker Zeitung*, 1891, vol. xv., pp. 846, 847. Sulphate of aluminium is dissolved in one-third of its weight of water, and the solution is mixed with finely-powdered wood charcoal; this operation being performed at the temperature of boiling water, and the proportions being as follows:—Sulphate : carbon :: 1 : 3. The mixture is stirred until it forms a thick paste, which is dried at 70° Centigrade, and subsequently ignited to a cherry-red heat in a retort, air being excluded. During the ignition sulphurous acid is given off, and this is passed away by means of pipes into heaps of moist clay, kaolin, bauxite, or some other aluminous materials, when it is absorbed. After this operation has been going on for a considerable time intermittently, it is found that a quantity of aluminium sulphate has formed, and this may be extracted from the heaps by means of water and used in the preparation of further quantities of the so-called "alumina-carbon." If the "alumina-carbon" be intended for the manufacture of aluminium by electrical means, it is well to add more carbon and to mould the mixture into rods prior to ignition. These rods possess a considerable electrical resistance, which may be regulated to a nicety by varying the percentage of carbon and their dimensions.

Swansea National Eisteddfod.—A professor of phrenology, during the holding of the National Eisteddfod at Swansea, a few weeks back, took out an electric battery one day and, posting himself near the Pavilion, invited passers-by to test his battery. The whole thing was evidently of a decidedly novel character to those who were in the vicinity of it, for at the close of the day the professor found that he had taken over £4 in penny tries.

Mansion Lighting.—The visit of Mr. Joseph Chamberlain to Wales will not improbably lead to the introduction of the electric light into one of the ancient mansions of the country. Highmead Mansion, Llanybyther, the seat of the Lord Lieutenant of Cardigan, Colonel H. Davies-Evans, is entirely lighted by means of oil, the nearest gas works being many miles distant. The large organ-hall, which is part and parcel of the house, where Mr. Chamberlain delivered his address, was illuminated by means of kerosene lamps, candle candelabra, and 1,000 tiny lamps of different colours. A few minutes before the arrival of Mr. Chamberlain one of the kerosene lamps fell from its bracket upon the head and shoulders of a journalist, and one of the papers in the Principality states that ere another political meeting is held in the same hall the present mode of lighting will be, in all probability, supplanted by the electricity, which will also be used throughout the mansion.

Leclanché Batteries.—The Leclanché battery being so extensively used, has, like all other useful articles, met with a great deal of keen competition. This matter is commented upon in the American *Electrical World* by Mr. C. J. Hirlimann, who says that this type of battery has of late years suffered very seriously from the result of attempts to cheapen manufacture. The performance of two cells, which are apparently the same, may differ considerably, and this is due to the fact that one manufacturer takes every care to use good material, while others, desiring to save a few cents, supply a battery giving most unsatisfactory results. At the present day we seldom find instances of cells that have been used and done good work from two to six years, simply for the reason stated above. This means a serious loss of public confidence in what is really a most useful battery, as well as injuring the manufacturer's reputation, if he has any.

Pure Platinum and its Alloys.—Platinum can now be prepared by a new process, the details of which have not transpired, in a state of such purity that it does not contain more than 0·01 per cent. of other metals. When the metal possesses this degree of purity it is too soft for many purposes, but it can readily be alloyed with iridium when in this state, and the result is a product of very great durability; the most suitable proportions are platinum 98—99 per cent., iridium 2—1 per cent. The pure iridium used in making these alloys by W. C. Heraus had a specific gravity of 22·35, and was extremely hard, being equal in this respect to blue-tempered steel. It was completely indifferent towards nearly all chemical re-agents, and only fusible in small quantities in the strongest heat of the oxyhydrogen flame. Heraus has also prepared alloys of pure platinum and rhodium. He contributes a paper upon these alloys to the *Chem. Zeit. Rep.*, 1891, v. xv., p. 170.

Swansea Docks Electric Lighting.—The electric light at the Swansea Docks is likely to be augmented, if the proposed pier extension scheme is carried out. At the last meeting of the Harbour Trust it was suggested that the West Pier be extended a distance of 1,000 feet. By doing this, the Trust would be able to dispense with the services of a dredger, which at present costs them £500 a month, whilst the extension would confine the water in the harbour within narrower limits, accelerate the current, and prevent the precipitation of matter brought down from the valley. The scheme would cost £30,000, which would include the expenditure on extra electric lighting. Something definite will, in all probability, be decided at the next meeting of the Trust.

The new Swansea Arcade, between Goat and Waterloo Streets, is to be lighted with electricity when completed. The work is progressing satisfactorily, and the arcade is expected to be ready for use during the early part of next year.

Brussels-Amsterdam Telephone.—At the beginning of next year telephonic communication will be opened between Brussels and Amsterdam. The line will pass through Antwerp and Rotterdam, where telephone stations will also be established.

Tenders Wanted for Lighting Braga.—The Municipal Chamber of Braga, Portugal, invite tenders for the public and private lighting of the city of Braga, either by means of gas or electricity. Particulars can be seen at the Municipal offices.

Inverness and Electric Lighting.—Two consulting engineers have been appointed by the Special Committee of the Inverness Police Commission to report as to whether there is sufficient water-power in the neighbourhood to be used for the purpose of lighting the town by electricity.

Burton-on-Trent and Electricity. — The Gas and Electric Light Committee have received 16 tenders for fitting up the town with electric light. Enquiries are being made before the committee can make any definite recommendations on the matter.

Electric Tramways in America.—In a paper read by Capt. E. Griffin before the Montreal Convention of the National Electric Light Association, he stated that in the towns of St. Paul and Minneapolis, with a combined population of 350,000, there is not a single horse tram car in use. Minneapolis has 120 miles of electric tramway on the overhead system, while St. Paul has 75 miles electric and 15 miles of cable tramways.

The Electrical Executions.—The official report on the electrical executions, by Drs. Macdonald and Ward, have now been published, and from an American contemporary we understand that it contains very little more than is already known. The only thing that seems to have been proved is that alternating currents of slightly under 1,500 volts applied in a particular way, not met accidentally, require a little less than a minute in order to permanently suspend all vital functions.

Electric Light Post Wrecked at Chelmsford. — An alarming mishap occurred in Duke Street, Chelmsford, last week. For some unaccountable reasons the horses of a hotel omnibus ran away. After upsetting a dust cart, the horses arrived at an electric light post, when they went one on each side of it, the post being snapped off just below the ground. The arc lamp at the top of the post fell with a tremendous clatter, making the horses more violent, but no further accident occurred.

Increased Electric Lighting in Berlin.—A report of the Berlin Electrical Works shows that from June 30th, 1890, to July 1st, 1891, there was a large increase in the number of consumers, namely, from 872 to 1,314, being about 50 per cent.; the sale of lamps has increased from 74,959 to 104,100. Orders for an additional 25,000 to 30,000 normal lamps have been secured for next winter. Electricity is also largely used for business purposes, the company having considerably reduced its tariff.

The Air Gap in Dynamos.—The day has passed for electrical engineers to look on the air gap as a necessary evil to be minimised as far as lay in their power, and since Messrs. Esson and Swinburne's papers of February last, a more rational view of the matter has been taken. The latest contribution on this point is a paper by Professor Ryan, published in our New York contemporary. Professor Ryan's results are on the whole confirmatory of the ideas of the two English engineers, and so their theory of the air gap seems now settled on a fair basis, though there is doubtless a good field for more experimental research in the matter, especially in the way of directly measuring the fields of dynamos under various loads. In the paper are given some interesting accounts of badly designed machines working well, owing to the peculiar action of the saturated horns, and no doubt some useful hints can be gleaned from it in this direction.

Telephones in Austria.—Negotiations have been concluded between the Ministry of Commerce and the Telephone Company of Austria for the transfer to the State at the end of next year of all the telephone lines at present worked by the company.

The Admiralty and the Electric Light.—We understand that the Admiralty have ordered estimates to be forwarded for the entire lighting by electricity of the Naval Barracks at Sheerness. The work will be pushed on as rapidly as possible, and it is believed will be put out to contract.

The Electrical Fittings Manufacturing Company.—A receiving order was made on Saturday last at the London Bankruptcy Court against Victor Selberberg, of 47, Oxford Street, W., trading under the above style. The petition was lodged by Mr. W. H. Jameson, acting on behalf of creditor, the act of bankruptcy alleged being the execution by the debtor of a deed of assignment on September 30th.

The Electric Light at the Brighton Pavilion.—The Brighton Town Council have resolved to place new fittings in the Pavilion, and connect it as soon as possible with the corporation electric lighting system. At a council meeting it was stated that the present lamps would have to be altered, as the town system differed; but the old plant would be utilised where possible.

Electric Lighting at Torquay.—The local authorities seem somewhat at a loss as to what course to pursue with regard to the proposed installation of electric light for the bath saloons and the town generally. The idea of obtaining the motive power from the waterworks has been deemed inexpedient. The Electricity Committee intend proceeding to work cautiously, and to obtain the opinion of some expert, if necessary.

Failure of Fire Alarms.—Considerable uneasiness has been felt in Sydenham on account of the failure of one of the local fire alarm communicators, and the consequent delay in the arrival of the engines at the recent fire in Sydenham Road, as the result of which the house was completely destroyed. The Lewisham Board, last week, resolved to call the attention of the London County Council to the circumstance, and to enquire what guarantee the public have that the fire alarms are kept in working order.

The Effect of Pressure on the Electromotive Force of Batteries.—According to the results of experiments made by M. Henri Gibault on this subject, and which are described in somewhat lengthy papers in *La Lumière Electrique*, the effect of pressure is to augment the electromotive forces. In the case of a Daniell element the variation is, however, very small; with the De la Rue element it is rather more marked, though still small. In the Lalande-Chaperon a diminution of force is noticeable.

Electricity versus Gas at Swansea.—From time to time there has been considerable talk with respect to Swansea substituting electricity for gas. The question has been introduced at the County Council meetings, and more than one discussion has ensued as to the advisability of making the change. Although no decision has yet been come to by the council in the matter, the question has been by no means abandoned; it is simply shelved for the present, and, if local rumour be true, is likely to form a prominent item on the agenda at one of the meetings in the near future.

Cadogan Electric Light Company, Limited.—A petition for the winding up of this company, subject to the supervision of the High Court of Justice, was, on the 30th day of September, 1891, presented to the High Court of Justice, Chancery Division, by Henry Lowenfeld, of 31, Lowndes Square, in the county of Middlesex, Esq., a creditor of the said company. The petition was directed to be heard before Mr. Justice Kekewich, sitting at the Royal Courts of Justice, Strand, London, on the 31st day of October, 1891; and any creditor or contributory of the said company desirous to support or oppose the making of an order on the said petition may appear at the time of hearing by himself or his counsel for that purpose.

Indestructible Water Tap.—Sir William Thomson has invented a water tap which may be said to be reliable as well as indestructible. There can be no defects in the way of washers, as there are none used. Such an article as this, which could be thoroughly relied upon, has often been sought for, and Sir William's patent tap should prove a great boon to householders.

Projected Electric Light at the Mumbles.—A correspondent writes:—"Electricity is likely to be introduced at the Mumbles before the advent of next summer. The innovation, it is stated, will come from the hands of the Langland Bay Hotel Company, Limited, whose already large premises are being considerably added to. Messrs. Perry and Co., the well-known contractors of Bow, London, E., have been entrusted with the work, and for the sum of £17,000 have stipulated to build a suite of bedrooms, a set of private baths, refreshment rooms, ball and billiard rooms, tap and bar. It is expected that with the completion of the new buildings the whole will be lighted with electricity."

Swansea and Electric Traction.—Swansea people will not be surprised if in the near future they can boast of an electric tramway in the town. There is a great outcry for tramway extension from the large and densely populated districts of Pentre-Estyll, Trelveth, Plough, Brynhyfryd, Tredennan, and Uyndd-bach, all of which lie on the outskirts of Swansea. Although such an extension is becoming year by year of greater and more imperative necessity, the local tramway company people do not appear to be inclined to open up any further fresh ground, and as a consequence of this it is stated in local financial circles that a syndicate will in all probability be formed for the purpose of opening an electric tramway to run through the districts in question.

Electric Lighting at Bournemouth.—It is proposed to light the new municipal offices by electricity, the estimates to be included in the scheme for the electric lighting of the pier and pleasure grounds. It has been suggested, however, that the power of the engine and pumping apparatus at the sea waterworks for the lighting of the new offices should be utilised, instead of going to the Electric Light Company. At a recent meeting of the Bournemouth Town Council a question was raised as to whether the Electric Light Company proposed to lay their wires underground or overhead. It was stated that during the storm the telephone service was practically useless. The Mayor replied that, as the council were so thoroughly against the erection of overhead wires, the company did not contemplate placing them otherwise than underground.

Electric Works for Crystal Palace and District.—On Saturday last, the operations of the Electric Installation and Maintenance Company, at Sydenham, were formally commenced by the laying of the foundation stone of their works at Springfield Wells Road. Amongst those present, in addition to the directors, manager, and consulting engineer of the company, were Mr. Geo. T. Rait, deputy chairman Crystal Palace Company, Mr. Henshaw Russell, manager Crystal Palace Company, General Cook, Mr. Hume Williams, Colonel Gouraud, Mr. Jonas Levy, Mr. J. Irvine Courtenay, and many influential residents of the district. After the ceremony the guests adjourned for luncheon to the Crystal Palace, after which Mr. J. E. H. Gordon, the contractor, explained fully the intentions and prospects of the company. At starting, provision is to be made for producing about 500 H.P. of electrical energy, the whole of which is to be transmitted to the Crystal Palace for the purposes of the Electrical Exhibition which opens on January 1st next. During the time the exhibition remains open, mains will be laid throughout the area comprised in the Company's Act of Parliament. It is hoped that by the time the exhibition closes consumers will have been found for the full amount of current then rendered available for public and private lighting or other purposes. The system to be adopted, owes much of its present state of perfection to the efforts of Mr. Parker and Mr. F. King, which we described in last week's "Notes." The buildings now in course of erection provide room for duplicating the plant when necessary.

An Electrical Name Plate and Indicator.—A novel apparatus has been invented by Mr. T. J. Thompson, of Chicago. It represents a combination push button, name plate and indicator, and is for the purpose of indicating to callers whether the occupants of houses are "in" or "out."

Bognor and Electric Lighting.—Referring to our note of last week on this subject, we are requested by the Electric Trust, Limited, to contradict the statement that the Bognor Local Board had decided to oppose the application of this company, as the extension of time has been granted to them.

Fire in a Telephone Switch-Room.—One night last week a fire suddenly broke out in the switch-room at the Bournemouth Central Exchange of the Western Counties and South Wales Telephone Company. The whole apparatus became suddenly alight, and the operator states that he had a narrow escape. He attributes the fire to the contact of overhead electric lighting wires, caused by the boisterous wind.

Rotary Current Motor.—A rotary current motor was exhibited in operation during the last few days of the Frankfort Exhibition by Messrs. Siemens and Halske. The armature, according to a Frankfort paper, consisted of an ordinary Gramme ring with a commutator having three brushes. The speed of the motor is said to have been regulated by the position of the brushes.

The New Telegraph Machine.—It is stated that the "new" telegraph machine referred to in our last issue was, according to Zetzsché's Handbuch der al. Telegraphie (I., 429), invented in 1868, and that since then it has been improved from time to time. The chief postal authorities are said to have declined, as recently as 1887, to have anything to do with the Jaite apparatus.

The Electric Lighting at Dublin.—We are glad to say that the electric lighting operations at Dublin are again actively progressing, although the stoppage of the work to which we referred some weeks ago, will prevent the lighting of the streets by electricity next month, as was originally intended. The *Dublin Evening Telegraph* stated on the 12th inst., that *in the course of a few days* the streets will be besieged by gangs of workmen for the purpose of laying down the culverts and boxes for carrying the distributing cables; but we understood more than a month ago, that the mains were to be "commenced immediately." The latest information to hand, however, is that some thousands of lengths of pipes are at present lying in Messrs. Hammond and Co.'s stores, ready to be laid down in the streets, and that as soon as the formal approval of the Board of Trade, the Postmaster-General, and the telephone, gas, and tramway companies to certain plans has geen given, the excavations of the streets will be immediately commenced. Under the circumstances it is impossible to prognosticate as to when the work will be completed. The delays seem almost incredible.

The Crystal Palace Electrical Exhibition.—We are authoritatively informed that the question whether or not the electrical exhibition, to be opened at the Crystal Palace on January 1st next, will be thoroughly representative is most satisfactorily answered by the high standing of the firms who have already sent in applications for space, and by the varied nature of their exhibits. That the exhibition will form a complete record of 10 years' progress is now a matter of absolute certainty. The requests for space—which already exceed a total of 200—include electric lighting plants for country and town houses, for mines, for steamships, for railway trains, and even for private carriages. There are also included the newest forms of motors, generators, accumulators, and other machinery employed for producing and storing electricity. Not only will the most eminent British electrical and engineering firms, with scarcely an exception, be represented, but several of the more important exhibits at the Frankfort Exhibition will be transferred to the Crystal Palace. The apparatus section will include a complete set of Sir William Thomson's standard electric instruments, new electro-medical and electro-thermic apparatus; the latest improvements in telephony and telegraphy, and also the most recent electrical appliances for war purposes, blasting, signalling, &c.

The Emperor William and Professor Helmholtz.—The Emperor of Germany has conferred upon Prof. Helmholtz the honour of an appointment to the membership of the Privy Council, with the title of Excellency.

The Electric Light in the Strand.—The offices of the well-known publishers, Messrs. E. and F. N. Spon, in the Strand, are being fitted with the electric light by Messrs. Woodhouse and Rawson.

The Telephone in London.—This topic has broken out again in the *Times* correspondence columns. On the 14th inst. Dr. Julius Maier signs, as a letter to the editor of the *Times*, an article which appeared in our contemporary, *Electricity*, on the 9th inst. advocating the continuance of earth circuits, whilst we understood all schools of telephonists were agreed on the ultimate necessity of return circuits.

Cardiff and Electricity.—The sub-committee appointed to investigate the advantages of electricity for the town of Cardiff left London on Thursday week for Paris, *viâ* Dover. They were to visit the electrical exhibition at Frankfort, but on their route to that place they intended to call at Paris, Brussels, Cologne, Berlin and Vienna. As the train in which the party travelled was leaving Charing Cross Station, Mr. Lascelles Carr shouted, "Tell the people of Cardiff that we will make whatever sacrifice is necessary to visit all the electric light centres on the Continent."

Halifax and Electricity.—At the last meeting of the Halifax Town Council the question of substituting electricity for gas was discussed. The mayor stated that the present electric lighting company had reached the limit of their production, and if any further supply of electricity were needed by the town the plant would have to be removed to another part. The company had suggested that now was the best time for the council to take over its plant and supply electricity to the town. The matter was adjourned pending the result of the negotiations between the corporation and the electric lighting company.

Underground Railways for New York.—A New York cable, dated October 20th, reads as follows:—The Rapid Transit Commission will present to-day their recommendations regarding the solution of the problem in this city. The chief features of their plan are underground railways on each side of the city and an underground railway across town underneath Union Square and Fourteenth Street; express trains running on special lines at the rate of 40 miles an hour; electricity for power and lighting; the block system and the latest methods of ventilation. The railways would be 30 miles in length, embracing 100 miles of single line.

The Institution of Civil Engineers.—The following subjects for papers (Session 1891—92), upon which the Council of the Institution of Civil Engineers invites original communications may interest our readers:—The best arrangement of Engine for any given Electric Light Station; The Application of Electricity to the Treatment of Sewage; The Electro-deposition of Copper; On Pyrometers of various kinds, the different objects they are applied to, and their practical use and working; Electrical Traction for Roads and Railways, and the adaptation to such purposes of the vehicles at present in use; Electrical Motors for (*a*) Inland Navigation (*b*) Ocean Vessels; The most suitable Form of Electric Light Mains, having regard to durability, economy of conducting material, and facility of making and laying house connections; The application of Electricity to Smelting and Metallurgical Operations; Electrical measuring instruments—such as Ammeters, Voltmeters, Power-meters, and Supply-meters. The annexed premiums were awarded for papers read during last session: Telford medals and Telford premiums to Llewelyn Birchall Atkinson, A.K.C., and Claude William Atkinson, A.K.C., Assoc. M.M. Inst. C.E., for their joint paper on "Electric Mining Machinery"; a Telford medal and a Telford premium to Rookes Evelyn Bell Crompton, M. Inst. C.E., for his paper on "The Cost of the Generation and Distribution of Electrical Energy"; and a Telford premium to William Langdon for his paper on "Railway Train Lighting."

The Electric Light in Milan.—The Milan central station is at present supplying current to 22,000 incandescent and 843 arc lamps.

The Institution of Electrical Engineers.—The third annual dinner of the Institution will be held at the Criterion Restaurant, Piccadilly, on Friday, November 13th.

Electric Lighting of the Mansion House.—At a cost of £1,500 the Mansion House is to be lighted by electricity, on a plan which has been prepared by Mr. W. H. Preece.

The Heilmann System of Electric Traction.—It is reported that experiments will shortly be made on one of the French railways with the Heilmann system of electric traction to which we recently referred.

Electric Cranes in Hamburg.—An electric crane has been tested with satisfactory results on the Petersen Quay in Hamburg. If this continues to work well it is proposed to extend the use of cranes operated electrically.

Personal.—A very interesting paper, entitled, "The Life and Work of Rankin Kennedy," written by F. L. Pope, appeared in the New York *Electrical Engineer* for October 14th. A speaking likeness of the Scotch electrical engineer adorns the text.

Leamington and Electric Lighting.—A monthly meeting of the District Town Council was held last week, when the Watch Committee submitted a notice from the Aurora Electric Lighting Committee of their intention to apply to the Board of Trade for an order empowering them to supply electricity to the borough.

Overhead Electrical Tramway Wires.—It is rumoured that in one or two localities the practical desire to be able to get easily about is overcoming the sentimental objection to overhead wires, and electric tramways are going to be introduced. There is little doubt, says *Industries*, that as soon as one or two electric tramways have been completed with overhead wires, many will find that the alleged disfigurement of the streets is largely a matter of sentiment.

Edison on the Track.—Referring to our note last week under this heading, we notice in the *Standard* a letter from Messrs. Merryweather and Sons, in which they say that it would appear from the particulars given in that paper that the invention had merely secured similar results to those by the closed conduit system, invented by Mr. John Gordon, and patented some two years ago. Messrs. Merryweather think it is only fair that a Scotchman should have some of the credit for the discovery which is at present solely claimed for Mr. Edison, who can well afford to share his laurels in the matter with British talent. A series of successful experiments have been carried out at their Tramway Works, Greenwich, on the Gordon system, with excellent preliminary results.

A Nuisance in St. James's.—A letter appeared in the *Times* on Monday last from some person under the *nom de plume* of "Piccadilly," warning the public, and especially the sanitary authorities, of an intolerable nuisance and a seemingly great danger with which they think they are threatened by the extended use of the electric light. His chief grievance seems to be an unfounded belief that the waste steam from the St. James's station is forced into the sewers, forming an olfactory nuisance, if not an atmospheric poison. Replying to this letter, Mr. F. J. Walker, the general manager of the St. James's and Pall Mall Electric Light Company, Limited, wrote as follows:—"My company does not, either at its station in Mason's Yard or elsewhere, force any waste steam into the sewers, but discharges it from a chimney shaft at a height of 130 feet above the ground." "Piccadilly" returns to the charge and says that whether from the sewers or from the top of the chimney it is all the same. His sleep is disturbed by foul odours, and he expresses his pleasure at learning that the Vestry of St. James's have taken the matter in hand. Is this a bare-faced attempt to depreciate the St. James's Company's shares? If such was the intention we hope the West End gentleman will be disappointed.

Electric Tramway in Leeds.—The Roundhay electric tramway, in the borough of Leeds, on the Thomson-Houston system, will be opened on Thursday, the 29th inst. We wish the promoters and contractors every success, and trust that it may be the forerunner of many other tramlines worked with overhead conductors.

Obituary.—We regret to learn of the suicide of Mr. C. F. Heinrichs, which sad event occurred but a few days ago in Chicago. In the early days of electric lighting in London Mr. Heinrichs was well known as the inventor of a dynamo and a circular carbon arc lamp. The deceased had resided in America since the time of his legal dispute with Mr. Westinghouse some years since, when it was decided in the English law courts that he had no case.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Institute of Medical Electricity, Limited.—The following was filed on the 10th inst.: "At an extraordinary general meeting of the Institute of Medical Electricity, Limited, duly convened and held at the registered office of the company, 35, Fitzroy Square, London, W., on September 15th, 1891, the subjoined special resolution was duly passed, and at a subsequent extraordinary general meeting of the said company, also duly convened and held at the said place on October 1st, 1891, the subjoined special resolution was duly confirmed:—'That the Institute of Medical Electricity be wound up voluntarily, and that John Walter Biggs, of 12, Delahay Street, Westminster, be appointed liquidator to conduct such winding up.'"

Bournemouth and District Electric Supply Company, Limited.—The statutory return of this company, made up to the 10th inst., was filed on the 15th inst. The nominal capital is £50,000 in £5 shares, of which 5,725 have been taken up, £3 per share called upon 2,570 of them, and £7,271 paid out of £7,710. The remaining 3,155 have been issued to the Brush Electrical Engineering Company, Limited, as fully paid. Offices: Observer Chambers, Albert Road, Bournemouth.

Aurora Electric Lighting and Distribution Company, Limited.—The statutory return of this company, made up to to the 12th inst., was filed on the 13th inst., The nominal capital is £25,000 in £1 shares. 35 shares have been taken up, the full amount called and all calls paid. Office: 54, New Broad Street, E.C.

Maxim-Weston Electric Company, Limited.—At an extraordinary general meeting of this company, duly convened and held at Winchester House, Old Broad Street, E.C., on Thursday, August 7th, 1890, the following extraordinary resolution was passed:—"That it has been proved, to the satisfaction of this meeting, that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up accordingly"; and at the same meeting John Marks, Esq., of 113, Great Russell Street, Bloomsbury, auctioneer, and James Hodgson, Esq., of 19, Queenhithe, E.C., were appointed joint liquidators for the purposes of such winding up. (Filed on the 17th inst.).

LEGAL.

Electric Arms and Ammunition Syndicate, Limited.—The petition to wind up this undertaking came again before Mr. Justice Jeune, sitting as the Vacation Judge, on Wednesday last, Mr. Marten, Q.C., appearing for five petitioners, and Mr. Millar, Q.C., for the company.

A meeting of the company, of which we published a report last week, was held on October 9th. After some discussion on the affairs of the company,

Mr. Justice JEUNE said that as to the serious question that the company had failed within the decisions of the Courts, he thought he ought not to look at the prospectus for the purpose of construing the memorandum of association, which appeared to him clear and to speak for itself. An agreement had been made with an American company to purchase what the chairman of the company had very fully described in the letter which had been read as a battery suitable for the purpose of the syndicate. He (his lordship) came to the con-

clusion that the company was within its rights and duties in improving the details of the article so far as was necessary to their purpose. It appeared to him that for the last two years they had been endeavouring, like most inventors, to realise their hopes, and he did not think he could say the time had yet arrived when he should say that the company had so far failed that it should be wound up. He therefore dismissed the petition, with costs.

J. and R. Blair v. J. and R. Howie.—This was an action brought beford Lord Low, at the Edinburgh Court of Sessions, in which Messrs. J. and R. Blair, manufacturing chemists and electrical and mechanical engineers, Irvinebank, Kilmarnock, sued J. and R. Howie, Hurlford Fireclay Works, near Kilmarnock, for payment of £88 2s. 7d., the cost of putting an electric lighting installation at the defenders' colliery, near Kilmarnock.

On the motion of counsel, his Lordship dismissed the action, and found neither party entitled to expenses. In terms of an arrangement the matter has been entirely referred to an engineer to see that the dynamo is put into working order to his satisfaction.

BUSINESS NOTICES, &c.

Woodhouse and Rawson's Catalogue.—By the publication of Section 6 of List B, Messrs. Woodhouse and Rawson United, Limited, have almost completed what will probably be the most comprehensive and satisfactory catalogue of electrical machinery and apparatus ever put together. Their "List of Contractor's Electrical Supplies," as originally designed and announced, was to consist of a book of 450 pages, illustrated by 800 wood engravings; but its scope has become so extended, that when complete, it will contain 600 pages, and at least 1,000 engravings. For convenience it is divided into 11 sections, so that any one can be supplied separately. Section 1 relates to boilers, engines, turbines; 2, dynamos, alternators, transmission of power plant, motors, accumulators; 3, arc and incandescent lamps and holders; 4, switches; 5, fittings and shades; 6, instruments, meters and telegraph apparatus; 8, machine tools, lathes, &c. Sections 9, 10 and 11 are in the press. In each section the amount of descriptive information is of such a valuable and interesting character, as to render the book indispensable to every one engaged in electrical work.

Lubricating Pump.—Messrs. John Greenwood & Co. are introducing a new apparatus called the patent challenge lubricating pump, which is specially suitable for high speed machinery, and has been found to work satisfactorily up to 1,000 revolutions per minute. The pump is actuated by the agency of friction, by means of an eccentric placed in direct contact with the shaft, thus obviating the danger of necks becoming heated, as sometimes happens from the breaking of bands, or otherwise, when other lubricators are used. The oil flows continuously to the neck of the shaft through a tube, and can be pumped almost any distance from the cistern. There is said to be a great saving of oil, as it is used over and over again, and as ordinary ball valves are used, there is no adjustment or attention required after the pump is fixed.

Electric Lighting.—Meesrs. Ernest Scott and Mountain, of Newcastle, have recently completed the lighting of Messrs. Arthur and Co.'s extensive new works in Glasgow, probably the most complete installation in Scotland.

Messrs. Drake and Gorham have put in a complete lighting plant for about 100 lamps, at the country house of Mr. A. Longman, at Shendish. The gas engine when not employed in charging accumulators for the lighting, is set to pumping water for the house.

The lighting of Preston is to be undertaken by the National Electric Supply Company, Mr. Walter Emmott being the managing director. The low tension system is to be adopted, and the orders already in hand justify the anticipation of a remunerative consumption immediately the works are completed.

J. G. Statter and Company.—This re-constituted firm, consisting of Mr. J. G. Statter, Mr. Leonard Milne and Mr. Henry Foote, have issued a descriptive pamphlet of plant recently supplied, accompanied by some testimonials. A list is given of important works upon which Statter dynamos, engines, and other apparatus are employed. The firm continues the manufacture of dynamos, motors, transformers, engines, and other specialities with which the name of Statter has hitherto been associated, and have taken works at Cuba Street, Millwall, where they have facilities for manufacturing on a large scale.

Croggon & Co.—Messrs. Croggon & Co. have found their electrical department so successful that recently an extension of accommodation had to be made. The showroom, formerly on the top floor, was removed to the street level, and increased space was thus found for specimens of the latest fittings and accessories. The top floor is now an extended workshop in which are employed a largely increased staff of men. A special telephone list is about to be issued by the firm, to be followed by another devoted to electric light requisites.

W. T. Glover and Company.—Messrs. W. T. Glover and Company wish to call attention to their new registered telegraphic address, "Glovers, Salford." This firm has been very busy all the summer, and has been obliged to put down additional plant to meet the increasing demand for their manufactures. Mr. Henry Edmunds has now returned from the Electrical Congress at Frankfort, and can be consulted at Messrs. Glover and Co.'s office, 39, Victoria Street, Westminster.

Driving Belts.—Mr. John Tullis, of Glasgow, has issued a reprint of a paper on "Belt-Driving," communicated by him to the Convention of British and Irish Millers held in Glasgow, June 17th, 1885. The anxiety of all users of motive power being to adopt the best, the simplest, and the least troublesome system of transmitting that power, this little paper may be commended as stating concisely what may be said in favour of leather as against ropes.

Silvertown.—The India-Rubber, &c., Company, are sending out a price list of electric light cables and wires, dated October, containing a special notice that in future every length of not less than 110 yards of vulcanised India-rubber insulated cable or wire of their standard classes will bear a label giving the minimum insulation resistance (after 24 hours' immersion in water) of such cable or wire per mile at 60° Fahr.

Jensen Electric Bell and Signal Company.—We are informed that Messrs. Jensen, who have continued to manage the business in the Gray's Inn Road, although it was taken over some months since by Messrs. Woodhouse and Rawson United, Limited, have now ceased their connection with it. In the course of the present month the business is to be removed to Cadby Hall.

Walsall Electrical Company.—A change has taken place in the constitution of this firm. Mr. Howard W. Bishop has ceased his connection with the company, and the business will in future be carried on under the same name as heretofore by Mr. Frederick Brown.

Sale of Machinery.—On Thursday next, October 29th, Messrs. Wheatley Kirk, Price, and Goulty conduct a sale of useful engineering plant at 323D, Kennington Road, particulars of which will be found in the usual place.

Ray Diffusers.—Messrs. Rashleigh Phipps & Dawson, who have done exceedingly well with the bead ray diffuser, promise a new diffuser possessing points of variance which constitute an improvement on the one now in use.

Typewriters.—The Commercial Cable Company recently gave a substantial testimonial in favour of the typewriter in general, and of one form in particular, when it issued an order for a thousand Caligraphs.

Brush Electrical Engineering Company, Limited.—The offices of the Secretary and Manager of this company will in future be at Albert Buildings, 49, Queen Victoria Street, the office of the Chief Engineer remaining as before at Belvedere Road, S.E.

Measuring Instruments.—Messrs. Richard Frères have issued, through their London agent, Mr. J. A. Berly, a descriptive list, in English, of their self-recording measuring instruments, signalling instruments, electricity meters and other electrical apparatus.

Vacancy for Inspector.—The County Council are in want of an inspector, at a salary of £200 a year, to test electric lines and works and to certify meters. Particulars will be found in advertisement supplement.

Berly's Directory.—We would ask advertisers and others who have not yet sent in their instructions for the new issue, to do so without delay, so as to facilitate its early publication.

Ransomes, Sims and Jefferies.—A new catalogue of steam engines and machinery has just reached us from this firm.

CITY NOTES.

Brazilian Submarine Telegraph Company, Limited.

SIR JAMES ANDERSON presided at an ordinary general meeting of the Brazilian Submarine Telegraph Company, held on Wednesday last at Winchester House, Old Broad Street.

After the SECRETARY had read the notice convening the meeting,

The CHAIRMAN, in taking the report (published in our last issue) as read, said he did not know whether the shareholders would consider the remarks he was about to make as encouraging or discouraging. He felt constrained at the last meeting to call the attention of the shareholders to acts of competition, and he would not keep back anything that they ought to know relating to the position of the company. He would earnestly call their attention to one or two items in the report. They had increased the agencies by establishing at Buenos Ayres a most important agency. It was this which accounted for the greater part of the increase of £500 under this head, as compared with the corresponding period of 1890. He also anticipated that they would be compelled to add to this for other agencies. There was an increase of £218 necessitated by the increase of work; they must further add to this amount the sums expended on the duplex system a few weeks ago, and the laying on of water at Madeira station, costing £187. Travelling expenses and sundry items were larger in consequence of dealing with the increase of an abnormal traffic. As a set off, there had been a saving in expenditure as follows:—Electrical expenses showed a decrease of £361; the sanatorium at St. Vincent, which cost £600 last year, did not again appear. Cost of repairs was £595 less, showing altogether a reduction of £1,350, so that there was in the aggregate a decrease in the working expenses and an increase in revenue of £33,920, and the gross revenue is £150,000. They had referred in the report to the fact that

the increase of revenue was largely due to the disturbances in South America, and the current half-year would have to bear the cost of repairing the Pernambuco cable, amounting to probably at least £10,000, and the cost of the duplicating cable about £6,000. That would show the wisdom of carrying forward a large sum. There was a balance under revenue of £11,191, which had hitherto been in dispute. Of course, they could not look forward to a recurrence of such items in the revenue, neither for a recurrence of the disastrous revolutions, which had greatly augmented the receipts for the last twelve months. In fact, the company must be prepared to anticipate a period in which the cry for economy and retrenchment in political and commercial circles would reduce the revenue. Nor was that all which had come upon them. When he (the speaker) had the honour to preside at the meeting six months ago, he pointed out upon the map the various lines which were being promoted; since that time one line, the French Antilles cable, extending from Hayti, in the West Indies, to within a short distance of the terminal station of their partners, the Western Brazilian Company, had been completed and opened for traffic. Up to the present time the rival line had not done them much harm, but it would take some traffic. He did not know if the new company intended to lower the tariff, and he did not think it would be wise for the Brazilian Submarine to initiate a war of tariffs. The termination of the war in Chili enabled the Central American Telegraph Company to start again, but they had had to count with this act of competition for a number of years, and they had not suffered much. As to the amount of injury which they could do in future, a good deal depended upon the question of the Central American adopting a non-remunerative tariff, and extending the cables to the coast. Another rival cable they were assured would be laid in about six months; the injury in this case would also depend upon the tariff adopted. It was certain that whatever tariffs any of the new companies adopted, they, the Brazilian Submarine, would adopt the same or a lower one, and it was beyond controversy that each and all their rivals would regret a war of rates more than they would. Of course they had no right to complain because promoters engaged in such enterprise, if their judgment could not see anything better for the exercise of their energies and the expenditure of their money, and following where the Brazilian Company had led, who for a great many years had struggled on without any increase of revenue, and borne the heat and burden of the day, and paid a 5 per cent. dividend. Imitation was the sincerest form of flattery, and if they were vain they might take credit for foresight and sagacity in erecting the first cable to Brazil, but it would not do any good to the interests of the shareholders, and they desired no consideration upon that score. They must let sentiment alone. They had seen the possibility of these companies coming into existence for years back, there was no way of avoiding it without paying large sums for concessions and laying unnecessary cables, thus depleting the resources of the company without any profit. They had left that for others, and now they were to look on and see how far that expenditure was judicious, and to study how they could meet the competition. They had adopted the policy of increasing their reserve and laying another cable out of it, thereby augmenting their carrying capacity without adding to their capital, and were thus able to convey the large traffic which a reduced tariff might develop. The Western and Brazilian Company had also duplicated their system over their most important sections, and they were both establishing duplex over every section of their cable. They were not without resources to carry their energies into the pastures of their rivals. Everything they now did, even to hold their own, would cost them money. Their reserve was a substantial amount, and they were as ready for the fray, if fray it must be, as any of their rivals, who had so far only single cables. He had thought it only fair to warn the shareholders that they must not expect a continuance of a dividend of 8 per cent. Since 1876 they had from time to time made reductions—varying according to locality or destination from one-third to 57 per cent.—in the original tariff, and they would in all probability have further reduced the tariff before now but for the rival cables which they had seen springing up. At present, however, they were, they thought, justified in waiting for their rivals to take the first step, if they intended doing so. A reduction of tariff on the part of their company at this moment would be a deliberate throwing away of money, and it would not stop any of their rivals from promoting their schemes. He concluded by moving the adoption of the report and the payment of a dividend of 1s. a share, making with the interim dividends 6 per cent. for the year, and also a bonus of 4s. a share in respect of the profits for the year.

MR. FREDERICK YOULE seconded the motion, which was carried.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

THE 36th ordinary general meeting of this company was held on Wednesday last at Winchester House, Old Broad Street, E.C., Sir JOHN PENDER, K.C.M.G., presiding.

The notice convening the meeting was read, also the minutes of the previous meeting. In taking the report as read (an abstract of which was published in the ELECTRICAL REVIEW last week),

The CHAIRMAN said: Before asking you to approve of the report, I will, as has been my custom, make some references to it. The gross receipts for the half-year under review amounted to £264,878, against £254,856 for the corresponding period of 1890, showing the substantial increase of £10,022, and this would have been greater but for the fact that the accounts include two months' receipts at the reduced rates, which I shall more particularly refer to later. The working expenses have been £71,476, against £76,670 for the corresponding previous half-year, showing a decrease of £5,194, which is accounted for by the ships' expenses being lighter during the past six months than in the corresponding half-year of 1890. The net revenue has amounted to £155,165, against £136,675 for the corresponding period of 1890, showing an increase of £18,490, due to various causes. Two interim dividends at the rate of 5 per cent., amounting to £62,500, have been distributed, and the balance, £92,665, is carried forward. The conversion of the 6 per cent. debentures, to which I alluded at the last meeting, into 4 per cent. debenture stock, has been satisfactorily completed, and it is gratifying to find that the new stock is quoted in the market at a substantial premium, from 6 to 8 per cent. This was the stock to which I referred last year, and which was distributed amongst our shareholders at par. During the last six months a renewal has been made in the Tonquin-Hong Kong cable; about 140 knots of cable have been inserted since the last meeting, and the cable is in good working order. The cable length is 469 miles, and by degrees we shall complete the whole of it. Several small interruptions have occurred during the past half-year, but the traffic has been practically uninterrupted, owing to duplicate lines. Since the close of the half-year the Penang cable has broken a short distance from where the renewal was made last year, but the duplicate cable laid last year is carrying the whole of the traffic, and no inconvenience has therefore been experienced. Fine weather is now reported to have set in at the Bay of Bengal, and the screw steamer *Recorder* will lay by in the vicinity of the break in a few days, and it is anticipated that communication will be restored very shortly. The company's station at Elephant Point, which was in danger owing to the rapid encroachment of the sea, has by an arrangement with the Indian Government been closed, and a considerable portion of the cable picked up and used elsewhere. Arrangements have also been entered into for extending the company's system to Sumatra, therefore an additional source of progress is expected. The length is about 166 knots. The cable will, moreover, open up an alternate route to China, and it will be provided from the stock at Singapore, and the work will be carried out at comparatively small cost. I have to announce the death of one of our colleagues, Sir Thomas Fairbairn, Bart. Sir Thomas was one of our directors from the early days of this company, and although during the last few years he had suffered from bad health, still his mind was clear up to the very last. We do not propose to fill up his seat on the board at the present time. The board is a good working board, and we are rather full at the present moment, but we shall always make it a point with our board whenever a good man drops off to replace him when we have an opportunity of doing so with a man that will be useful in the company's interests. I have given you some particulars of the work that we have been doing during the last six months, and I will supplement those remarks by saying that I am satisfied that you will be pleased with the accounts which we put before you to-day. Very few companies can carry forward the amount that we are doing, and, upon the whole, looking to the fact that only about twelve months' ago I announced to you here that we were negotiating for an alteration in our tariffs with the Australian colonies, our position is satisfactory. Six months ago I told you that we had completed these negotiations to our satisfaction, and to-day I am able to tell you, after some little experience of the working of the reduced tariff from 9s. 4d. to 4s., I believe the reduction will be a marked success, that the companies will not lose in any way by it, and the telegraphing public will benefit very largely indeed; but in saying this, I must also make the remark that we have been dealing with an English speaking people—people that know the value of telegrams, people who use it for commercial purposes, and they find that the more they use it, the more the trade grows, and that is our hope for the future. We cannot calculate upon the same results from people who know nothing of our energy and nothing of our views on this side. I speak of India. Of course, as you know, the English element in India is a comparatively small one to the population, and we never recoup to ourselves the amount we lost by reduction. The same applies to China; we have made reductions, but have not got the same return. I make these remarks in the view that English merchants in India and in China will just think twice before they allow themselves to go back in the commercial race. I believe that now telegraphs are established, a connection betwixt this company and the commercial interests all over the world, that it is impossible to carry on business unless they use the submarine line. I have had some experience of commercial life, and I know that where the energy is applied, and the strong will is exercised, that they will find that the more close they keep with other countries, the more prosperous will their commercial relations be. I cannot say much of local progress, but when competing with the Japanese and Chinese, we have people who are very keen and persevering, and the good example set by the English community will be followed by them. They will see that what benefits the English, will also benefit them. The next time I meet you I think I shall be able to tell you that this reduction from 9s. 4d. to 4s. has been a practical success, and that it is likely to become a permanent institution. Now I cannot leave this subject of the reduction of tariffs without expressing, as I did last year, my thanks to the Agents-General of our colonies, who took part in this work. Two of them are about to leave, in fact, one has left, and I see from the papers that another is about to leave. Sir F. Dillon Bell was very much disappointed, as he took an active part in bringing about the arrangement; but unfortunately the state of things in his colonies did not admit of their sharing the risk. He is going back now to New Zealand, and I believe that his influence there in the political world will be of great use to us. I know we shall have a thoroughly good advocate of the system, which he believes to be the one to be crowned with great success, and that he will endeavour to bring New Zealand into it, so that she will share some of the honour of that success. Sir Graham Berry who has taken an active part in this business, retires to Victoria, and I know we shall have in him, also, an intelligent supporter of any system that will bring into more close relations the colony

in which he is a representative of the mother country. I know he believes the more they can work together the more will their respective interests be. I think, gentlemen, when I look to the speech which I read just before coming here that I made six months ago, it was so full in regard to the questions upon which I have been speaking, that there is really little to say, but the next six months I hope I may be able to congratulate you and the board and the colonies upon an important addition to this grand account, which is likely to prove so thoroughly satisfactory. Now, gentlemen, when we see everything progressing well, and as you know we have been paying you good dividends, adding to our reserve fund, and strengthening ourselves in every possible way, I think we ought not to forget the fact that a great company like this has now attained a position at which it ought to think of those who have been more or less instrumental in bringing about this result; I refer to our staff generally. We are anxious that a fund should be promoted and established for the purpose of giving pensions to those who live long in our service. This service is a peculiar one; it is one that requires intelligence; it requires honesty, and a good deal of self-reliance. You have to send out young men to their different stations abroad, and there is nothing that pleases me so much as to find from time to time that when our stations are visited by distinguished men from this country, the report always says they are a credit to the country, and the company which they represent. Knowing the important position they hold, and that they have to live like gentlemen, we want them, when the time comes that they must retire, to have something to look forward to in their retirement, and I think the company, in its day of prosperity, can justly and fairly contribute to the carrying out of this. It is proposed that the company should give something like 5 per cent. upon the salaries at the end of the year, that is, 5 per cent., will be placed in a fund, which will go on accumulating, and at a late period of life they will receive a pension. I am not asking you to-day to do anything. You previously have contributed towards an insurance fund. We are going to change that into this pension fund, which will require something like a couple of thousand pounds a year, to which every member of the staff has to contribute for the 2½ per cent. that the company is to contribute 5 per cent., and we hope in a few years to get up such a fund as will give a man more or less comfortable circumstances. I cannot put before you to-day full details. I have given you a large idea of what we want to do, and I feel confident that in the days of our prosperity you will not forget that there is something to do for those who have helped to bring about this. That is all I have to say, and while I shall put no formal resolution to-day about this business I hope in six months' time to be able to put before you a complete scheme. With these remarks I beg to move that the report and accounts of the directors now presented be received and adopted.

This motion was seconded by the Marquis of TWEEDALE.

Mr. NEWTON (a shareholder) said that he thought the proposal made by the chairman as to the pension fund was an idea with which he was sure there would not be one shareholder who would not agree. The shareholders owed to the directors of the company the successful management, but they must have got a splendid set of fellows abroad, and that was where their traffic largely came from. He thought the directors and the staff might be congratulated upon the successful report which was presented to them.

Mr. LEWIS (a shareholder) said he had served in many climates, and every person who had travelled in China and the Eastern Archipelago would know of the diseases and fevers of all kinds that they are subject to. When a man was broken down in the service, just as in the Army, he had claim upon such a rich and great company as theirs.

The CHAIRMAN thanked Mr. Newton and Mr. Lewis for their remarks, which he thought when printed and circulated would convey even more than any remarks he might make, as their staff knew that he himself was more or less interested, but when they found that the views of the chairman were approved of by the shareholders, it was a double and very largely increased satisfaction to them. After a few more remarks, the resolution before moved was put to the meeting and carried unanimously. The Chairman said that, before closing the meeting, he wished to add that he would like to have seen a good many more people there, as the directors liked a little encouragement as well as the staff.

Mr. GRIFFITHS (a shareholder) then moved a vote of thanks to the chairman and directors, which was carried unanimously.

The proceedings then terminated.

The Parisian Compressed Air Company.

IN connection with the debate which is likely to take place on the re-assembling of the Paris Municipal Council on the subject of the transfer of the canalisation project granted to M. Popp (to which we have already referred in the REVIEW), the Paris financial papers are just now devoting a large amount of space to the recent general meeting of shareholders of the above company. From these reports it appears that, notwithstanding increasing business, the financial period of 1890 showed a loss of 307,709 francs. The production of compressed air delivered at the works in 1890 was 180 million cubic metres, or an average of 494,000 cubic metres per day, showing an increase of 64 million cubic metres over 1889. The receipts of all kinds from subscriptions, in 1890, were 1,268,325 francs, an increase of 241,589 francs. The loss referred to above resulted from important works carried out in the course of the financial period under notice, in addition to the changes which the company had been obliged to introduce, forced, as it was, to carry over all its distribution by electricity in the sector which it had acquired in 1889, which had upset the whole of its calculations and caused serious trouble in its service. It arose, also, from delay in the work under the public thoroughfares, from the administrative formalities necessary to obtain permission to lay down the canalisation. These circumstances had made it impossible for the company to carry out the necessary and regular repair of the engines, boilers, and compressors, and from this negligence of keeping the apparatus in a state of repair a loss of more than 25 per cent. occurred in the production at the Saint Fargeau works. The miners' strike likewise had largely increased the price of coals. In short, the financial period of 1890 presented abnormal conditions, which were rendered more burdensome by the feverish activity which the company had had to display in order to finish its works and place its sectors on a footing of installation within the limits fixed by the specification. The following is the balance-sheet up to December 31st, 1890:—

ASSETS.

	Francs. c.
Capital, including industrial shares, costs of first establishment, engines, canalisation, working material, telephone lines, the Saint Fargeau experiment room, securities, electric sector, &c. ...	22,292,698.80
Stock in hand	837,962.30
Floating capital	214,982.75
Debtors' account	982,623.00
Loss for the financial period, 1890	307,709.15
Total of the assets	Fr. 24,712,976.00

LIABILITIES.

Share capital	10,000,000.00
Effects to pay	606,633.05
Creditors' account	621,876.80
Coupon No. 1	60.00
Rents payable at December 31st, 1890	11,548.90
Loans on mortgage and creditors' account	13,325,446.05
Consumers' securities	113,370.20
Reserve fund	11,347.00
Sinking fund prescribed by the agreement with the City of Paris, 10 per cent.	22,694.00
Total liabilities	Fr. 24,712,976.00

The above-mentioned loss of 307,709 francs is set forth in the following profit and loss account:—

	Francs. c
Creditor balance for 1889	52,558.40
Profit resulting from the clock-regulating, mechanics' and forging works	8,701.80
Subscriptions:—Pendulum motor power, lighting, &c.	1,268,325.15
Sale of goods, &c.	17,079.20
Profit on motor power installations	43,827.90
Profit on electric installations	61,184.20
Total	Fr. 1,451,676.65
On the other hand, the miscellaneous expenses for 1890 were 376,253 francs, and the working expenses 1,383,132 francs, or a total of	Fr. 1,759,385.80
Showing a loss of	Fr. 307,709.15

Commenting on this balance sheet, one of our Parisian contemporaries caustically observes:—What is very remarkable is the manner in which the profit and loss account is presented to the shareholders: General expenses so much; working expenses so much; and no other explanations. It is true that the seven shareholder founders know the ins and the outs and the object which they are pursuing, and that it is not necessary for the public to be enlightened on what passes between the Disconto Gesellschafft, of Berlin, M. V. Popp, and the Paris Municipal Council.

City of London Electric Lighting (Pioneer) Company.

AN extraordinary general meeting of the City of London Electric Lighting (Pioneer) Company, Limited, was held at Winchester House, Old Broad Street, on Tuesday last, the Hon. Alan Charteris presiding. The resolution "that the company be wound up voluntarily," which was passed at the extraordinary meeting of the company, held on the 30th ult., was submitted for confirmation at a special resolution. This was formally proposed by Mr. SAVORY and seconded by Mr. KEY, and carried unanimously.

A further resolution was proposed by Mr. SAVORY, seconded by Mr. KELLMAN, and also carried, that the Hon. Alan Charteris and Mr. Joseph Cecil Bull be appointed liquidators for the purposes of such winding up, at a remuneration of 50 guineas each.

The Eastern Telegraph Company, Limited.—The Eastern Telegraph Company, Limited, announce the payment by warrants on 2nd November next, of interest for the half year ending October 31st, on their 4 per cent. mortgage debenture stock. The transfer books will be closed from October 28th to November 2nd, both days inclusive.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended October 16th, amounted to £4,461.

The City and South London Railway Company. Traffic receipts for last week amounted to £794.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 16th, 1891, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Company were £3,535.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Oct. 15th, 1891.)	Closing Quotation. (Oct. 22nd.)	Business done during week ending (Oct. 22nd, 1891.) Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —102	100 —103	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	48 — 49 xd	48½— 49½xd	48½	48
2,849,510*l*	Do. do. 6 p. c. Preferred	Stock	86½— 87½xd	87 — 88 xd	87⅞	86⅞
2,849,510*l*	Do. do. Deferred	Stock	12¾— 13¼	12⅝— 13⅛	13 3/16	...
130,000	Brazilian Submarine Telegraph, Limited	10	12 — 12½	11⅝— 12¼	12¼	12 1/16
53,200*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978*l*	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅛— 3⅜	3¼— 3⅜	3⅜	3¼
69,996*l*	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	1⅞— 2⅛	2 — 2¼	2¼	2
50,000	City and South London Railway, Nos. 1 to 50,000	10	2 — 4	2 — 4	...	...
$7,716,000	Commercial Cable, Capital Stock	$100	125 —130	125 —130	131⅛	129
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	7/16— 9/16	7/16— 9/16	½	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	5 — 5½	5 — 5½	...	...
16,000	Cuba Telegraph, Limited	10	10 — 11	10 — 11	...	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3½— 4	3½— 4	...	...
6,000	Do. do. 10 p. c. Preference	5	9½— 10½	9½— 10½	...	...
60,710	Direct United States Cable, Limited, 1877	20	10⅞— 11⅛xd	10⅞— 11⅛xd	11 1/16	10⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅛— 14⅜xd	14⅛— 14⅜xd	14⅜	14⅛
70,000	Do. 6 p. c. Preference	10	14¾— 15¼xd	15 — 15¼xd	15 5/16	15⅜
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	107 —110	108 —111	110½	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅝— 15⅛xd	15⅛— 15⅜xd	15¼	15
78,300*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	104 —107	104 —107	...	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 —107	104 —107	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	106 —109	106 —109	...	...
135,000*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	...	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6⅞— 7¼	6⅞— 7¼	7⅜	7 1/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ..	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅛— 2⅜	2⅛— 2⅞	2⅜	2 1/16
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3⅛— 3⅜	3⅛— 3⅜	3⅜	3 5/16
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1⅞— 2⅛	1⅞— 2	1⅞	1 13/16
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜— 9⅞xd	9⅜— 9⅞xd	9⅞	9 11/16
180,042	Do. do. 6 p. c. Preference	10	14¾— 15xd	14⅜— 15 xd	15⅛	14⅜
150,000	Great Northern Tel. Company of Copenhagen	10	18¾— 19¼	18¾— 19¼	19	...
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	105¼	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 466*l* to 14,000 ...	10	8 — 8½	8 — 8½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	10 — 11	9½— 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	20 — 21	20 — 21	20⅜	20⅛
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	43	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	7 — 8	6 — 7	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8¾— 9¼	8¾— 9¼xd	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6⅜— 7⅛	6⅜— 7⅛	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	106	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	9¾— 10¼	9¾— 10¼	...	...
447,234*l*	National Telephone, Limited, Nos. 1. to 438,984	5	4¼— 4½	4⅜— 4⅝	4½	4 7/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13	12½— 13	12 15/16	12½
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 13	12 — 13	12¼	12
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	105 —107	105 —107	106¾	106
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	3½— 4½	5½— 6½	...	...
220,000*l*	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16— 5/16	3/16— 5/16	...	...
9,000*l*	Reuter's Limited	8	8 — 8½	8 — 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅞— 8¼	8 — 8½	8⅜	8 1/16
7,900	Do. do. do. 7 per cent. pref.	2	7 — 7¼	7 — 7½	7⅜	7¼
3,381	Submarine Cables Trust	Cert.	118 —123	117 —122	118½	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	5 — 5½	5 — 5½	5⅝	5½
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43½	42½
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
3,200*l*	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7½— 8½	7½— 8½	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	97 — 100	98 —110	99	...
30,000	West Coast of America Telegraph, Limited	10	3½— 4	3½— 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	98 —103	98 — 103	...	...
67,007*l*	Western and Brazilian Telegraph, Limited	15	10¾— 11¼	10¾— 11¼	11⅛	11
30,364*l*	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	7	...
30,364*l*	Do. do. do. 5 p. c. Deferred	7½	4½— 4¾	4½— 4¾	...	...
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	103 —106	...	...
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅛— 1⅜	1 — 1¼	1¼	1
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	8¾— 9½	8½— 9	8¾	...
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	7½— 8½	7 — 8	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
42,853	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5⅞— 6⅛	5½— 6	6	5 15/16

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 60—62.—Ordinary of £10 each, £4 paid, 4¼—4½.—Electric and General Investment, Shares of £5, £1 paid, 1⅞—2¼.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem. fully paid, 1—1¼.—Elmore's Priorities, 3¾—4⅛.—House to House Company (£5 paid) 4⅛—5.—Liverpool Electric Supply, Shares of £5, £3 paid, 3¾—4⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 1¼—2⅛.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅜ — ⅝.—National Telephone Debentures, 2½ — 3 prem. —Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2⅛—2⅜.—£5 Preference, fully paid 3¾—4.—Debentures 90—95.—Wards Electric Car, £10 paid, ¾—1.

BANK RATE OF DISCOUNT.—3 per cent. (September 24th, 1891).

NEW PATENTS—1891.

16,870. "Improvements in the combination of electrical brush, brush-holder and lubricator." T. SUTCLIFFE and E. H. ATKINSON. Dated October 5th. (*Complete.*)

16,874. "The utilisation of the tidal rise and fall for dynamic purposes." B. H. THWAITE. Dated October 5th.

16,875. "Improvements in automatic electrical apparatus for signalling and preventing accidents on railways." J. GRANT. Dated October 5th.

16,895. "Improvements in electric arc lamps." J. B. SPURGE. Dated October 5th.

16,931. "Improvements in electric meters." E. C. GRASSOT. Dated October 5th. (*Complete.*) [Date applied for under Patents Act, 1883, Sec. 103, 4th April, 1891, being date of application in France.]

16,934. "Improvements in secondary or storage batteries." H. H. LAKE. (Communicated by P. Kennedy and C. J. Diss, United States.) Dated October 6th.

16,938. "Improvements in secondary or storage batteries." H. H. LAKE. (Communicated by P. Kennedy and C. J. Diss, United States.) Dated October 6th.

16,941. "Improvements in switches for electric lighting." A. P. LUNDBERG. Dated October 6th.

16,958. "Improvements in or relating to metallic junction boxes or cases for conductors or fittings for electric lighting, electric bell circuits, and like purposes, and in the mode of connecting the conductors thereto." H. A. MAVOR, W. A. COULSON, S. MAVOR and W. B. SAYERS. Dated October 6th.

16,977. "Improvements in lightning rod staples." H. WHINCOP. Dated October 6th.

16,989. "Improvements in printing telegraphs." H. H. LAKE. (Communicated by M. G. Farmer, United States.) Dated October 6th. (*Complété.*)

16,991. "Improvements in type printing telegraphic apparatus." F. H. W. HIGGINS. Dated October 6th.

17,003. "Machines for making grids for secondary batteries." A. F. MADDEN. Dated October 6th. (*Complete.*)

17,019. "An improved magnet applicable to fluids in bottles, powders, and salves in boxes and the like for medicinal purposes." S. TOWNSEND. Dated October 7th.

17,032. "Duplex plates or discs for electrical health appliances." T. SMITH and J. C. HALL. Dated October 7th.

17,042. "Improvements in and relating to dynamo-electric machines applicable for the traction or propulsion of any vehicle, vessel, or body, as well as for all purposes to which dynamo-electric machines may be suitable." J. MACHAFFIE. Dated October 7th.

17,074. "Improvements in electrical subways." J. C. REILLY. Dated October 7th.

17,107. "Improvements in electric arc lamps." J. H. RIDER. Dated October 8th.

17,118. "Improvements in arc lamps." T. TUBINI. Dated October 8th.

17,119. "Improvements in electrical switches." W. C. CHEESEWRIGHT. Dated October 8th.

17,148. "Improvements in electric switches." W. B. SAYERS. Dated October 8th.

17,160. "Improvements in and relating to electric accumulators." H. H. LAKE. (Communicated by La Société dite Electriciteits-Maatschappij (Systeem de Khotinsky) Germany.) Dated October 8th.

17,192. "Improvements in electric distribution." A. WRIGHT. Dated October 9th.

17,227. "Improvements in electric cables." J. C. HOWELL. Dated October 9th.

17,231. "Improved winding for drum armatures of dynamos and electro-motors." SIEMENS BROS. & COMPANY, LIMITED, J. NEBEL and F. H. VALTER. Dated October 9th.

17,264. "An improved self-winding electric clock." J. RICH. Dated October 10th.

17,291. "Improvements in electric soldering irons." W. MITCHELL. Dated October 10th. (*Complete.*)

17,310. "Electric signalling apparatus for use with a network of electrical lines or conductors." L. VON ORTH and E. BRESLAUER. Dated October 10th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

10,624. "Improvements in dynamo-electric machines." W. H. SCOTT. Dated July 9th. 8d. Consists in splitting up as much as possible the pole-pieces, and, where possible, the magnets in a direction parallel to the direction of the lines of force due to the coils on the magnets, but cutting across the direction that would be taken by lines of force that would be produced by the cross current turns in the armature. 3 claims.

12,475. "Improvements in electrical smelting." E. TAUSSIG. Dated August 9th. 6d. The material to be smelted in a state of sufficient tenuity is included in the circuit between electrodes of large surface, and of suitable material, preferably of the same metal as that which is to be smelted out. The heat necessary for smelting is thus produced by the resistance at the numerous points of contact in the material. The reduction in the production of heat due to the increase in the cross section of contact in the material as the smelting progresses is equalised, or substantially equalised, by the increased temperature of the smelting material, so that the temperature is maintained at the requisite height during the whole process of smelting. 1 claim.

13,619. "Improvements relating to electric conductors for traction purposes." A. L. LINEFF. Dated August 29th. 8d. Relates to improvements in the means for supplying electricity for traction purposes described in specifications No. 10,092, July 11th, 1888, and No. 1,644, January 30th, 1890, and the object of the present invention is to reduce leakage between the continuous conductor and the underflanges of the magnetic surface rails, and to enable the conductor to be laid down in a more perfect and expeditious manner than heretofore. To this effect, the inventor increases the depth and width of the channel formed by the insulating tiles, and rests the copper conductor on earthenware insulating supports placed at intervals along the channel. The copper main he makes of U-shape or similar section, so as to present a considerable amount of rigidity in a vertical direction, and he places it in the centre of the channel. The conductor will thus be completely surrounded by air, except at these supports. 3 claims.

13,735. "Improvements in apparatus for use in electro-metallurgical operations." C. HOEPFNER. Dated September 1st. 8d. Relates to an apparatus which is more especially designed for use in carrying out the process for obtaining metals described in the specification of letters patent, No. 4,626, dated March 26th, 1888, but also for similar electrolytic or galvanic operations. 6 claims.

14,050. "An improvement in electrical cut-outs." SIEMENS BROS. AND CO. (Communicated from abroad by Messrs. Siemens and Halske, of Berlin.) Dated September 6th. 6d. The fusible metal strip is made of approximately semicircular form, narrowed about its middle. Its ends are bent first at right angles, and again at right angles, so as to form feet, which are pressed on a pair of terminal plates by a circular cap held to a circular base by a central bolt and nut. Both the cap and the base are made of earthenware or other suitable insulating material, and the cap is chambered so that the fusible strip is left quite free within it. When fusion of the strip has taken place, it is only necessary to unscrew the nut and raise the cap, in order to place a fresh strip in the chamber. 2 claims.

14,609. "Improvements in electrically-propelled vehicles, in the arrangement and connections of the motors and power transmitting devices thereof, and the method of operating the same." B. J. B. MILLS. (A communication from abroad by E. H. Johnson, of New York.) Dated September 16th. 8d. Claims:—1. The method of operating an electrically-propelled vehicle, which consists in successively closing circuit to two or more electric motors mechanically connected with the wheels of the vehicle in starting the same, substantially as described. 2. The combination of two or more electric motors mechanically connected with the wheels of a vehicle for propelling the same, and a switch for throwing the motors successively into circuit, substantially as described. 3. The combination of the vehicle, the two or more motors, each of the motors being connected with the wheels of the vehicle through devices which permit it to gradually apply its power, and electrical connections such as that the motors may be successively introduced in circuit. substantially as described.

19,942. "Improvements in galvanic batteries." W. P. THOMPSON. (Communicated from abroad by F. Marx, of Berlin.) Dated December 6th. 6d. Claims:—1. A regenerative iron and carbon battery distinguished by an electrolyte containing chlorine in loose chemical combination, which can be made either of hydrochloric acid (HCl) and a chlorate of any suitable element, or of hydrochloric acid (HCl) and iron perchloride in a watery solution. 2. In the battery described in Claim 1, a protective bandage for the iron electrode, consisting of a covering of damp silk paper, with a covering of thick blotting paper over that, and, surrounding both of these coverings, a cover of shirting, dowlas, linen, or other similar material from which the finishing has been removed.

20,986. "Improvements in apparatus for electrically welding and otherwise working metals." H. H. LAKE. (Communicated from abroad by H. Lemp, of America.) Dated December 23rd. 8d. Relates to the construction of that class of electric metal working apparatus in which the work is heated by the passage of an electric current, and movement is given to the work while heated in the welding, upsetting or other operation. 8 claims.

AMERICAN LIGHTING STATISTICS.

THE United States Census Office has just published some most exhaustive figures as to the partition and cost price of street lighting by the different systems of lighting by coal gas, water gas, and electricity. Fifty of the largest towns have furnished complete particulars of the total length of their public thoroughfares, the number of apparatus classified according to their nature, the average annual cost of lighting, the number of apparatus per mile of street and per square mile of surface, the cost of each kind of lighting, and the division of that cost per head. From the tables drawn up by the Census Office, it appears that the annual cost per gas lamp varies between the maximum of $50 at New Orleans, $43.80 at San Francisco, and $37 at Saint Louis, and the minimum of $15 at Indianapolis and Canton, $15.60 at

Minneapolis, and $17.50 at Hoboken. The annual cost of the electric light varies between the maximum of $440.67 at San Francisco and $237.25 at Boston, and the minimum of $58.46 at Denver and $68 at Chicago. The last-named city has the greatest length of streets, 2,048 miles, and there the total number of lighting apparatus is 32,793, made up of 24,878 gas lights, 422 electric lights, 6,714 carburetted gas, and 779 oil, showing an annual cost of $640,784. There are 240 apparatus per square mile, 16·01 per mile of street, and 1 per 33·54 inhabitants. The annual cost per apparatus is split up as follows :—Per coal gas lamp, $20 ; electricity, $68 ; carburetted gas, $16. The lighting cost per inhabitant works out at the rate of $0.45 for coal gas, $0.026 per electric lamp, $0.98 per carburetted gas burner, or a total cost of $0.58. Hoboken (Jersey) is the one among the fifty towns whose public thoroughfares present the smallest development, 30 miles. The total number of lights is 211, which is made up thus :—91 gas lamps and 120 electric lamps, which together cost annually $19,200. There are 144 lights per square mile, 7·03 per mile of street, and 1 per 206·86 inhabitants. The annual cost is $17.50 per gas lamp, $146 per electric lamp, and the cost per head $0.4 per gas burner and $0.401 per electric lamp, or $0.44 per head per year. In towns of more than 100,000 inhabitants, the average number of lights of all kinds is 219 per square mile, or 13·5 per mile of public thoroughfare. There is 1 per 47 inhabitants, and the average cost for public lighting is 67 cents per head. For towns of less than 100,000 inhabitants, there are 62 lights per square mile, 3·8 per mile of public thoroughfare, 1 per 71 inhabitants, and an annual cost of 65 cents per head. The Census Office has also collected figures for comparison from 278 towns having a total population of 7,018,653 inhabitants. The total number of lighting apparatus was found to be 91,467, in which electricity figured for more than a third, the number being 35,191, giving a total cost of $4,200,627 (£840,627), or $0.60 per head.

REPORT OF THE POST AND TELEGRAPH DEPARTMENT OF QUEENSLAND FOR THE YEAR 1890.

THE report of the Superintendent of Electric Telegraphs, Mr. A. F. Matveieff states that the total mileage of extensions completed since last report, dismantled line, &c., deducted, is 218¾ miles of line and 297 miles of wire. Several extensions are in progress. There are now (June, 1891) 9,881½ miles of line, and 17,490 miles of wire open for public business. At the close of 1890 there were 351 stations in daily operation, and 814 officers employed, including those holding appointments in other departments, but exclusive of assistants at country stations (officers' wives) and construction parties.

Although the report covers a period of 13 months, instead of 12 months as usual, the total number of interruptions to communication is considerably below what it has been for the last three years. This is no doubt attributable in a great measure to more favourable atmospheric conditions where the wires are most numerous, bush fires being less and not so destructive, and also partly the result of repairs and improvements effected on the lines. The very large increase of business during the past three months with the towns in the central portion of the colony has frequently blocked the lines to and in the vicinity of the disturbed districts, resulting in much delay to messages. This was unavoidable under the circumstances. The most serious interruptions in the Southern and Western Districts were as follows :—On April 3rd, 1890, a heavy flash of lightning fused a portion of the line wire 38 miles from Cunnamulla, on the New South Wales border side, and as the country was impassable the repairer was unable to reach the fault before eight days had elapsed. On the evening of December 15th a storm of cyclonic force burst over Brisbane, and amongst other damage in the city it bent the whole of the iron poles on both sides of Victoria Bridge, causing some inconvenience to vehicular traffic for a few hours. The wires were cleared from the roadway and repairs effected as quickly as possible, but, unfortunately, when nearly complete, a second storm on the 18th *idem* caused almost as much damage as the first. A plan for staying the poles is now under consideration with a view to prevent such damage and trouble in future. On December 22nd, bush fires destroyed 20 poles between Bollon and Cunnamulla, but the line was temporarily repaired in 32 hours. On January 14th, the wire became submerged in flood waters between Isisford and Welford Lagoon, and communication was not restored for 18 days. Between Camooweal and Lake Nash, on February 2nd, an angle pole and ten others were washed down. This and other defects caused by floods and the boggy state of the country prevented repairs being made for nine days. An interruption from floods commenced on February 25th, between Cloncurry and Boulia, and lasted eleven days. Another from the same cause was reported on April 5th last, between Isisford and Welford Lagoon, and the wire remained submerged for twelve days. The country around Welford, Jundah and Windorah has been almost continuously flooded during the last four months. By far the longest of the land line interruptions have been in that neighbourhood. Communication by wire beyond Jundah was stopped from April 2nd to May 12th last. Repairers were not able to follow the line. The causes of stoppage to traffic on the lines affected arose in 213 instances from faults in offices ; crosses with telephone wires, brackets, insulators, pins or tie-wires breaking, trees blown on lines, crosses caused by strong winds, interference with wires by maintenance parties and line repairers at work, bush fires, damage by lightning, trees felled on lines by timber getters, road parties, and others, wires submerged in or washed down by flood waters, and railway contractors at work are accountable for the bulk of the rest of the interruptions. In the central and northern districts the interruptions were comparatively few and not serious.

The expenditure for 1890 on maintenance and repairs was as follows :—

Southern district	...	...	£3,046 0 2
Central „	...	...	6,247 6 0
Northern „	...	...	3,231 12 10
Total	...	...	£12,524 19 0

The total number of messages transmitted and received (including international) were 1,329,925 ; and the revenue (excluding O.H.M.S., £20,240 7s. 11d.) £91,779.

CORRESPONDENCE.

Railway Train Lighting by Electricity.

The letters which have appeared in the ELECTRICAL REVIEW for the last two or three weeks on the above subject, have, I am sure, created afresh within the minds of many of its readers, a craving for a successful solution of this hitherto difficult problem, and it is highly probable that a continuance of this correspondence from those who have had practical experience in this branch of the electrical industry, will go far to elucidating same.

It is undoubtedly a great and important question, and if successfully applied and universally adopted, would supply a long felt want which all railway travellers by night must have noticed and remarked long ago. It is only within a comparatively recent period that experiments have been carried on with any success, and yet I am sure none will dispute but that it is yet in this stage.

I am perfectly sure the various railway companies would be only too pleased to listen and seriously consider any reasonable system that might be submitted to them for the efficient lighting of their carriages by any illuminant on any system whatsoever, provided it could be clearly shown to them that by its adoption they would ensure the public a superior illumination, and would hardly hesitate to pay a slightly increased price, seeing that they would be receiving a superior article.

And it is to this fact, I presume, with all due respect to Mr. Shippey, that was due, the non-entertainment of his marvellous thermo electric element system, so far back as three years ago, for it clearly proves that it was perfectly unadaptable to this class of work.

In his letter in last week's REVIEW, he leads us through the various items of Mr. Timmis's letter of the 2nd inst., with great clearness, and then when one thinks that he is just about to finish up, he plays off his trump card, if I may be allowed to use such an expression ; in other words, he explodes

upon us his grand and unique thermo-element system ; but the curious part is, just when we are beginning to recover from the shock, and become interested in his explanation (?) of this stupendous idea, the ink suddenly dries up, the pen is laid on one side, and that fertile mind ceases soaring into realms of imagination, leaving us totally in the dark as to what his ultimate plans would be. I suppose Mr. Shippey does not wish to commit himself until such time as he may have patented his idea. For my part, I would prefer the money in my pocket.

Reviewing the various systems of train lighting by electricity at present in use, that by means of which individual sets of secondary battteries light up independent carriages, seems to be the one most feasible and most successful, at least in this country.

I had hoped to have seen some mention made of the system devised by A. E. Porte, engineer to the Electrical Engineering Company of Ireland, and used with great success by the Great Northern Railway Company of Ireland for the last 12 months.

When the railway company first began to consider the question of electrically lighting their trains, they asked this Irish company to supply them with plans and specifications for the carrying out of the work ; several systems were considered, but ultimately that advocated by Mr. Porte was adopted. It consists essentially of a small generating plant, comprising gas engine, dynamo, and suitable instruments, situated at Amiens Street, their principal station in Dublin. This station is built alongside the line, so that carriages may be shunted up to the very door ; each carriage has one set of 18 C9 accumulators, placed in a special space allotted in the 1st class goods department. These cells give a discharge of 8 ampères for 9 hours and provide for a circuit of 35 volts, this pressure having been found by experience to be the best. The lamps are of 5 C.P. each, and each 1st class carriage contains 4, and each second class carriage 2, besides which there is one in the lavatory ; the lights in the 1st class are so arranged as to be placed at an angle just below the rack, but at the same time sufficiently high as to project the light well over one's head. The fitting consists of a silvered reflector countersunk in a substantial wood base, over which is fitted a clear glass bezel enclosed in a brass lock-up frame, the whole presenting a very pretty and ornamental appearance ; similar fittings to these are also used in the 2nd class carriages, but are placed in different positions. These lamps are more or less under the control of the occupants of the carriages, switches, countersunk in the woodwork, providing for the extinction of 3 lights in the 1st class, but the remaining lamp is always connected permanently to the cells, so that there is no fear of total darkness. The idea of four small lights instead of one or two large lights is worthy of notice ; although much more costly, it does away entirely with the possibility of a total burn out of the lamps, no four lamps in one cariage would go out simultaneously, besides which the light is better diffused.

To minimise the injurious vibration to which the carbon filaments would be subject by the oscillation of the train, bottom contact holders with suitable springs are provided, and lamps with contacts to match ; this has been found to answer admirably.

The cells being deposited in the carriages, all that now remains is to shunt them alongside the generating station, connect them in series by means of suitable plugs, and by the same means to the plug board in the house and commence charging ; when fully charged all plugs are withdrawn and they are then quite ready for their journey to Belfast and back.

This system has many obvious advantages ; by using the low voltage lamps the number are reduced to a minimum and therefore the weight, which is a great consideration.

The 18 cells weigh, when complete with acid, about 600 lbs., and I question whether Mr. Shippey can very materially reduce this by even using the Woodward multipolar cells.

2. Each carriage being distinct from the next obviates the necessity of disconnectiug and reconnecting, with the possibility of a short circuit when carriages need detaching.

3. The same plant which may charge several trains in series or otherwise during the daytime, may be utilised for lighting up the station in the evening.

4. The accumulators are so arranged that they are easily removed when necessary in a surprisingly short space of time, and a new set substituted.

5. By suitably packing these they are not subject to the oscillation of the train, therefore the acid is prevented from much washing, and the active material from falling out from this cause, thus decreasing the depreciation account. As regards the cost of this system of lighting *versus* gas, the mere fact of the railway company, after twelve months' experience, deciding to extend the application of same to their express trains should be sufficient without further comment, but perhaps a few rough figures would not be out of place.

Take for instance a train of 5 carriages, each with its set of 18 cells. To charge these in series it requires about 200 volts and 8 ampères, which equals 1,600 watts ; to produce this it will require from the gas engine an energy of about 2·5 brake horse-power, to develop which the engine will consume 22 cubic feet of gas per horse-power per hour, charging the cells for five hours the gas consumed will have amounted to $2{\cdot}5 \times 22 \times 5 = 275$ cubic feet, which at 3s. per 1,000 amounts to about 10d. ; add to this, man's time at 7d. per hour = 2s. 11d. ; oil waste, &c., 6d. ; depreciation and interest, 2s. = for 5 hours, 6s. 3d. ; this provides light for 90 5-C.P. lamps, each taking ·5 of an ampère for a period of 8 hours. Compare this with gas : 90 gas jets of about 5 C.P. each would take about 3 cubic feet per hour, so that for one hour these would consume 270 cubic feet, and for 8 hours, 2,160 cubic feet, which at 3s. 9d. per 1,000 (illuminating gas being more expensive than heating gas), would equal about 8s. 2d., so that it will be seen that without adding other charges, gas is the more expensive. Of course, it will be understood these figures are only very approximate, but, nevertheless, will give some idea.

It is to be hoped that the day is not far distant when all our trains, and all classes of carriages on same, will be lighted up by the electric light now that something has been commenced in that direction. I wonder Edison or some of our own great electricians have not ere this given their attentions to this great problem, perhaps they all have their various schemes, but all of which require just one detail to make its application a success ; alas this detail is never found out in many cases.

A.I.E.E.

[A gas engineer would certainly say that the estimate of 3 cubic feet per hour for a 5 C.P. light is nearly twice as much as is necessary. It is easy to make the cost anything we like on assumptions like these.—EDS. ELEC. REV.]

Transformer Losses.

As I have received several letters from friends pointing out an apparent mistake in my letter in the ELECTRICAL REVIEW, dated 2nd inst., on the above subject, perhaps you will kindly allow me to make that letter more clear, as it may be misleading to others.

It has been pointed out to me that, since the Foucault currents are due to an E.M.F. set up in the iron core, these currents diminish (other things being equal) with the increase of temperature ; and consequently $C^2 R$ will necessarily be smaller at a greater temperature. This is perfectly true *if the E.M.F. setting up Foucault currents is constant*. The correct way of expressing the Foucalt current loss is $\frac{E^2}{R}$ where E = E.M.F. setting up the currents and R = the resistance of the iron core. It is obvious from this that if R increases and E remains constant, $\frac{E^2}{R}$ becomes less. But in the transformer experiments made by Mr. Rider, and to which I was referring, we are told that the total volts in the secondary increased with the load, and the only assumption I made was that they increased in the same proportion as the increase of the resistance due to temperature. Such being the case $\frac{E^2}{R}$ will be, of course, greater, and will account for the increased iron loss. It is, however, probable that the Foucault volts increased at a greater rate than the increase of temperature of the core.

I may, perhaps, also be allowed to correct a printer's error in the letter as it appeared. In the bottom line on p. 406 the "a" in *a* $C^2 R$ should not be in italics as it is a part of the sentence and not of the formula "$C^2 R$."

Samuel Joyce, Jun.

Telephoning of Great Cities.

Will you permit me to state in reference to Mr. Miller's letter published in your last issue, that the Western Electric springjack mentioned by him is one of three types. The form now used occupies a space of ½ inch square. The jacks are made up in strips of 20; each strip is 11½ inches long and ½ inch high: 100 jacks therefore occupy a space of 11½ inches by 2½ inches. The length may be slightly reduced if occasion requires.

J. E. Kingsbury.

October 19th, 1891.

Will you kindly insert the following remarks on the interesting letter of Mr. Miller, which appeared in your last issue?

Mr. Miller has, no doubt, had as much experience of the call wire system as any one in this country, so that his evidence in its favour ought to carry great weight. I was rather surprised, however, to read that 60 subscribers to each operator's call wire was considered by him to be too great. On the ordinary multiple board the number of subscribers attended to by each operator is seldom, if ever, less than 66, or three operators to 200 subscribers. In America the general rule is to give 100 subscribers to each operator. As the movements required in making the connections with a call wire system are certainly fewer and less arduous than with an annunciator system, it follows that the operators should each be able to attend to more subscribers, and from what I have seen of the Mutual Company's Exchange at Manchester, such is the case. Mr. Miller should also remember that he is comparing his non-multiple Dundee system, where each operator has to make connections for all the calls *to* and *from* the subscribers she attends to, with a multiple system by which an operator has only to make connections for the calls *from* the subscribers she attends to.

Mr. Miller is mistaken in supposing that a break in the electrostatic call wire would cut off the subscribers beyond the break. Unless the break occurred so close to the switch-room as to make the capacity of the remaining part very small, none of the subscribers would be affected. If such a break did occur, it would only be necessary to join the call instrument to another spare wire in the cable to clear the trouble.

If there should be overhearing between the call wires on the new plan of working, it would, I believe, be easily remedied by providing the cables with an outer covering of lead foil connected to earth. The connections between the switch-rooms would, I should imagine, be made by through wires and not by static induction, as it is the *spur* wires to the subscribers' offices which Mr. Bennett intends to dispense with.

It is a pity Mr. Miller was not more careful with his figures, as he appears to have made the serious mistake of counting 12 square inches to the square foot, so that his calculations are altogether wrong, except in regard to the space occupied by 100 jacks of Mr. Bennett and of the Western Electric Company. The reduction of 31 per cent. in the space occupied by the former appears to me a very important matter in connection with a large multiple board, as it governs what is called the *ultimate capacity* of the board, or the greatest number of subscribers which can be connected to any one switchboard, so that a *jack* to each subscriber is within the reach of any one operator. The largest ultimate capacity of any Western Electric Company's multiple board at present in use is, I believe, 6,000. By using Mr. Bennett's jacks (which I may say are well within a workable size), the ultimate capacity of the board would be raised to nearly 9,000. The latter jacks can be made smaller than those of the Western Electric Company, because the springs are dispensed with and they are therefore simpler.

As Mr. Bennett's board is a horizontal one, operators can work on both sides of it, and therefore the *multiplying* or *repeating* of the jacks is only required to one-half the extent of that of upright boards. This in itself is a very important point. By adopting the call-wire system indicators are dispensed with, and the space which would have been occupied by them is available for the jacks. All these advantages combine to make Mr. Bennett's multiple board *the* one for dealing with a very large number of wires.

There will be no need to multiple the junction wires at the central exchange, as the operators have no need to reach the jacks of the whole of the junction wires, and the wires can therefore be divided up between the operators and distributed about a room or building in any way desirable. The floor space required for the 40,000 jacks would be very moderate, only 76·5 square feet in fact, instead of 918, as mentioned by Mr. Miller.

Mr. Miller's objection to the condensation of switchboards no doubt holds good in regard to non-multiple switchboards; but in the multiple ones, as I have already pointed out, it is a great advantage, and Mr. Bennett's is an important improvement, if only on this one point, as it renders a larger exchange practicable than would otherwise be possible.

From the Duke of Marlborough's letters in the *Times*, it appears that a mixed system of underground and overhead lines is contemplated for London. All the junction wires being underground, it will be easy to run a sufficient number of them (through the conduits to be constructed) to serve for some years to come.

Since 1886, when I visited Mr. Miller at Dundee, I have had a very high opinion of the "Mann" system, and now that this system is combined with multiple switchboards and metallic circuit lines, I thoroughly believe that the system produced is the one best adapted to grapple with the difficulties of the telephoning of a large city such as London. By itself, the "Mann" system was not so likely to make headway in large towns. Perhaps my opinion will have more weight when I mention that I am the inventor of the system adopted at the National Telephone Company's Manchester exchange, which is generally looked upon as the model exchange in this country.

I am a thorough believer in concentration into large exchanges, as far as possible consistent with cost, &c.; but in a place like London, with the present limitation of exchanges to not more than 10,000 subscribers, Mr. Bennett was compelled to adopt the plan of a large number of centres, if he were to provide for the future great extension in the use of the telephone.

The argument that because a system is not extensively used, therefore it is not the best system has, I think, very little weight. Many circumstances may tell against a system being adopted, such as vested interests, and difficulties and expense in making changes.

The figures given by Mr. Bennett for a Mutual board for 5,000 subscribers, viz., 104·7 square feet, were for one in which the connections had been multipled or repeated 10 times.

I would like to correct Mr. Bennett's figures for the Paris telephonic exchange. I find from your columns that the number of subscribers in Paris at the end of last November was 9,200, so that at the present time there must be very few short of 10,000 subscribers with metallic-circuit lines.

I am also of the same opinion as Mr. Bennett and Mr. Miller in regard to the fact that different systems in different towns is no bar to telephonic communication between the subscribers in those towns, and I have had much experience in these matters.

Apologising for trespassing at such length on your valuable space,

Joseph Poole.

I have to apologise to you, to Mr. Bennett, and your readers for a stupid blunder in my letter of 9th inst., where square feet have been arrived at (?) by dividing square inches by 12 instead of by 144. No doubt the error was at once apparent. I corrected it in a proof you were good enough to send me, but which it would appear did not reach you in time, and but for the delay in telegraphic despatch, consequent on the storm last week, the error would have been corrected independent of the proof before you had gone to press.

There are one or two other trifling mistakes in the text of my letter, but they are so obviously printer's errors, that it is unnecessary to further refer to them.

The law which I mentioned in my letter, viz., "that the switchboard must not be so condensed as to prevent the requisite number of operators getting access to it," is, I think, of great importance, and has not, so far as I am aware, been previously pointed out. For instance, if we take Mr. Bennett's figures of 104·7 square feet for a Mutual board for 5,000 subscribers, then, with say 50 subscribers per operator,

the working space available to each of the 100 operators is only 1·047 square feet, which seems ridiculously little. Again, he gives the length of this board as 44 feet 10½ inches. Even supposing he places one operator at each end of his board, he still has 88 operators to seat, say 44 at each side of the board. All I can say is that the Manchester young ladies must be much more ethereal than their oatmeal-fed sisters in Scotland.

It should in addition be noted that in the examples given no account whatever has been taken of junction and trunk operators, who nevertheless require space, excepting, of course, at an isolated exchange, like the Manchester Mutual, where junctions and trunks do not exist.

Referring to your remarks on my letter, I have further considered your ideas regarding "disadvantages in the intercommunication between exchanges employing different systems, and especially so for disconnections from many exchanges;" but personally I fail to see that the Mann or my plan of call wire on one or more of such exchanges can possibly be a disadvantage. Take the simple case of one exchange with indicators only (A), and another with the call wire (B), having trunk communication. Disconnection, then, is always easy and certain at the (B) end of the trunk wires. If by any means (B) subscribers have been left on, then (A's) operators ring right through to (B's) subscribers, and ask them to call off. If both exchanges were (A) ones, then disconnection at *both* ends would be, I think, difficult and uncertain.

I agreed with Mr. Bennett that your remarks about numbers of exchanges abandoning the call wire—*if applied to the Mann or its improved form*—were in error. The instance given by Mr. Goodwin in *India* was the Law call wire. I do not know of a single instance—does anyone?—where the Mann or its improvement once adopted has been abandoned, and I am inclined to think that the subscribers would have a word to say were the call wire withdrawn once it had been in use. You state, "We write with some reserve, but we also believe that the improved circuit wire plan described by Mr. Miller was in use at that (the original Law) exchange." This is news to me, and I would thank you to kindly confirm it with particulars.

I do not think that the advantages of an efficient call wire system have been well and fully known—of course, all may be assumed to have some knowledge of the Law, but that plan was quite inefficient—and perhaps this accounts to some extent for the call wire not having been more widely adopted hitherto.

With the improved call wire there are no indicators on the subscribers' main lines. When a connection is asked, say, "Fifty on three, five, seven" (50 on 357), the operator answers, "Right fifty," or repeats, "Fifty on three, five, seven," makes the connection by inserting the plugs, leaves "Fifty" to ring up his friend, and troubles no more about it until "Fifty" calls "Fifty off, please," when she withdraws the plugs. With the indicator system the process of ringing up and getting *both* subscribers before the connection is made is almost a necessity, otherwise any ringing will probably be taken as a "ring-off" signal. The difference of time occupied in making a connection in the two systems must be very apparent, without entering into the detail of numbers of movements at all. The trouble and unsatisfactoriness of "ring off" indicators is well known to everybody. You are disconnected when you don't want to be, and you can't get disconnection when there is nothing you more fervently desire. I make an exception, of course, in favour of the Post Office plan, where, to judge from what has been published, disconnection should be more readily effected.

Do not think that I am carried away by an enthusiastic or biassed view in favour of the call wire. I do not claim that it is perfect, and no one perhaps recognises such drawbacks as it has better than I do; but so far as my experience goes, everything has demonstrated the great superiority of service of an efficient call wire system, compared with that of any ordinary indicator system.

Jno. D. Miller.

Dundee, *Octoler 20th*, 1891.

[Should not Mr. Miller's figures towards the end of the third paragraph read 98 and 49? The reference to disconnections from exchanges needs to be carried at least one step further to (C). If we had been able to furnish the particulars asked for by Mr. Miller, we should not have written with any "reserve." Perhaps one of our transatlantic readers will give us the necessary definite particulars.—Eds. Elec. Rev.]

I trust you will allow me space to reply to Mr. A. R. Bennett's letter, which appeared in your issue of the 16th inst.

I was not at all surprised at the tone of Mr. Bennett's reply to my last letter, after reading his former letters on the above subject. It is gratifying to me to know that the only part of my first letter to which Mr. Bennett condescended to reply has brought forth evidence to prove that I was correct in my statement, and Mr. Bennett entirely wrong. This proof, coming from a gentleman who is described by Mr. Bennett as being his *late able assistant at Dundee* makes it doubly gratifying.

Since I am right in this instance, it is only natural to suppose that I am equally correct in my other statements. I thank Mr. Miller for his timely assistance in helping me to show that Mr. Bennett's *simple assurance* is not of such value as he would have your readers suppose, and I may safely leave it to them to decide who has *wantonly wasted* your valuable space—Mr. Bennett or I?

Whatever Mr. Bennett's friends and admirers may think of his telephonic and grammatical abilities, they cannot, after his last exposure of himself, claim that he is entitled to be considered a gentleman of the Chesterfield school. It is very unfortunate that an electrical engineer, who evidently considers himself of some importance, should use abusive language and wilfully and maliciously pervert facts, simply because his bare word is not considered sufficient.

I strongly object to the manner in which Mr. Bennett has altered the sense of my last letter to suit his own ends. His remarks that I must have kept in the background shows clearly that I am not a man after his own heart, and do not write articles and letters to the public press for the sole object of advertising myself.

If he will *carefully* examine electrical papers and directories he will find my name mentioned. His query as to whether I made the report in respect of sand causing induction in India, would seem to imply that he wishes your readers to doubt whether I understand electrical laws at all. Whatever Mr. Bennett's claim to superiority in the Law, Mann, Bennett "call wire systems" may be, I do not admit that he is in the least my superior in electrical knowledge generally. Unfortunately, up to the present time, he has given no chance for having this tested.

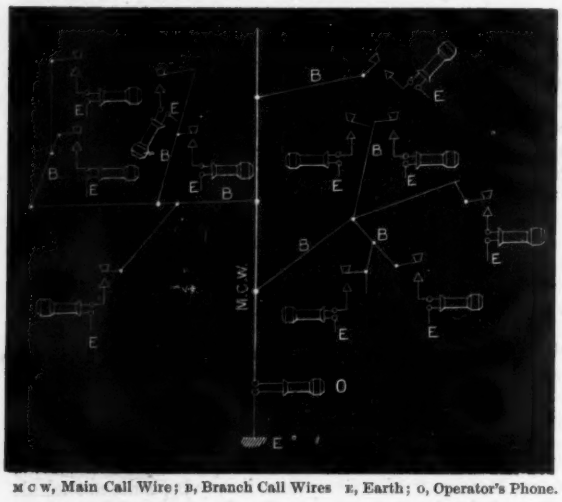
It would be very interesting to know if, previous to the introduction of telephones into Great Britain, Mr. Bennett claimed superiority to others as a telegraphist, as he would appear to now claim as a telephonist, for I do not remember having read anything respecting his remarkable abilities in that line; perhaps speed was not considered so essential in those days.

According to your note at the foot of Mr. Bennett's letter, this gentleman asked permission to *reply* to my letter, and I think I am within my rights in protesting against the use he has made of the privilege accorded him, by scurrilous reference to people not mentioned in my letter. Why, on earth, Mr. Bennett should have such a hatred of the National Telephone Company I cannot imagine, unless it be that this company has shown its ability to dispense with Mr. Bennett's services, and is able to carry on its business without his valuable assistance, which appears to be a great blow to him; and yet I cannot quite understand why it should be so, as, by his own showing, this company gives paltry salaries to lads who, in his opinion, are my equals. Surely, if such is the case, his own salary could not have been a very liberal one, and he ought to be thankful if he has obtained a more lucrative appointment.

Mr. Bennett's mention, in the same breath, of the small exchange in Manchester and the large one in Paris, I cannot but think is another comparison similar to *Peebles and Paris* or *Galashiels and London*. Does Mr. Bennett consider a telephone system of from 600 to 1,000 subscribers worthy of being thought an example of telephony on a *large scale?* I would also like to ask Mr. Bennett if he considered the people of India acting sensibly when they discarded some hundreds of instruments and replaced them by others of a different system, erecting at the same time the most expensive of switchboards; if the fault could at all be attributed to

bad construction, would it not have been cheaper to reconstruct their lines, especially as the wayleaves are granted by the local authorities, the tenants or proprietors of buildings having no voice in the matter? This question of wayleaves was brought into court by a wealthy Mahomedan who spent some hundreds of rupees, but failed to obtain redress. Or is this an admission on Mr. Bennett's part that the magneto system is superior to the "call-wire system," inasmuch that the former does not require such careful construction? Mr. Bennett should have more carefully considered these matters before presuming to call my letters *trash and nonsense*; but I can afford to laugh at remarks like these coming from such a source, especially as I have heard expressions from gentlemen well known in the electrical world that the trash and nonsense lay in another quarter; they also expressed surprise, accompanied with not very complimentary remarks, at Mr. Bennett's last exposure of himself.

Mr. Bennett's diagram is calculated to mislead. I doubt very much if such a system has been in practical use, except for very small exchanges. The system I used in India was worked according to the following diagram :—



M C W, Main Call Wire; B, Branch Call Wires E, Earth; O, Operator's Phone.

There were several sections constructed on these lines, all of which were at night connected to one phone. How much does this system differ from the one laid down by the expert (?) on telephoning large cities? We called it the Law, as nobody cared much at that time what name was given to a "call-wire system."

Mr. Bennett would have your readers believe that I know little of any system, and, to mislead them, he gives a theoretical diagram which is altogether useless for the points at issue, where practical work alone is required.

I do not quite understand Mr. Bennett's object in calling me the *little 'un*. Does he mean that I am small in stature or small in heart? In either case, he has misapplied the term, which could with advantage be properly applied to himself. Or does he mean that my letters show I am a *little 'un?* If the latter, he has decidedly fallen into a great error, for my letters have been said to contain some practical points, and have been proved to be correct, whereas his own letters have been called effusions, and proved to be incorrect.

When Mr. Bennett favours your readers with another letter I hope it will contain a little science, as a contrast to his others, and, above all, I trust it will be couched in a *gentlemanly* tone. *Verb sap.*

H. Goodwin.

October 20th, 1891.

I have read with some surprise Mr. J. D. Miller's statement in your last issue that from sixty to one hundred subscribers are too many for one operator to manage on Mann's switching system. Such was not my experience in Cumberland where I had charge for three years, from 1886 to 1889, of six centres worked on that system. The largest of these, Whitehaven, had seventy subscribers connected direct and twenty-five more connected through branch exchanges at Parton, Cleator Moor, Frizzington and Egremont. Whitehaven had also direct trunk wires to Workington and Maryport, and indirect trunks to Harrington, Cockermouth, Aspatria, Wigton, Dalston, and Carlisle. Owing to the iron and steel industry, coal and iron ore mining, and shipping, the West Cumberland district, with Whitehaven as its centre, was one of unusual telephonic activity, yet one operator coped with the whole traffic passing through Whitehaven switch room. Her work, at the lowest computation, was equal to that arising from one hundred and twenty subscribers connected directly. Yet the service was rapid and efficient.

Subsequently I had charge of the National Telephone Company's Sheffield district. Prior to my arrival a Western Electric multiple switchboard had been fitted at Sheffield. Notwithstanding that the messages per subscriber were fewer than in Cumberland, about seventy lines was the maximum number attended to by one operator, and the junction and trunk wires were kept separate and worked by a special girl. Yet the service was slower and gave less satisfaction to the subscribers, while the faults were more numerous.

There is one other point in Mr. Miller's letter on which he and I differ. I cannot reconcile his arithmetical conclusions with my own calculations. In converting square inches into square feet he has evidently divided by 12 intead of 144.

F. F. Bennett.

As I was manager in Aberdeen when the Mann system, with Mr. Miller's improvement, was introduced there, I should like to make some remarks on Mr. Miller's letter which appeared in your paper of last week.

I was not aware that in Dundee one operator could not attend to 60 subscribers even during the busiest hours of the day. A much larger number than that was apportioned in Aberdeen, and all the calls were answered and the connections made without any delay. About 540 instruments were connected with the exchange there, and six operators attended to them. This gives an average of 90 to each operator, which is now, doubtless, considerably increased. This subject was often referred to in conversations with Mr. Miller, and I was always led to understand that Dundee showed greater economy in operators than Aberdeen.

Mr. Miller says he takes Mr. Bennett's figures for the dimensions of the mutual switchboard, but in making his own calculations he has fallen into serious errors.

A 100-line section measures 5 inches square, and there is a partition $\frac{1}{4}$ inch in width between each section, when fitted into the switchboard. The space occupied by 50 sections is equal to 8·66 square feet. When allowance is made for the partitions and sides of the board the actual measurement of the board is found to be 9·5 square feet. Mr. Miller's mistake is that he has only allowed 12 square inches to the square foot instead of 144 as is usually done. The figures Mr. Miller gives for the W.E. jacks must also be divided by 12 to give the correct dimensions. His comparison, however, is very unfair and misleading, as he takes in the case of the Mutual the full dimensions of the *board*, and omits in the case of the W.E. the space necessarily occupied by the indicators.

The figures given for the 40,000 lines are all wrong. Anyone understanding the Mutual board can see how 40,000 lines can be arranged in one room. Mr. Miller is mistaken in supposing that Mr. Bennett's figures are not taken from an actual board. They represent the dimensions of the existing board in Manchester, in which "the ideal of the multiple system" is practically carried out.

I do not agree with Mr. Miller's estimate of the number of operators required, but I think he is quite correct in his remarks referring to inter-communication between exchanges, and to the vastly better service afforded by the call wire system.

Although I have pointed out the errors in Mr. Miller's figures, and suggested inaccuracy in some of his facts (?), I hope you still retain the satisfaction which his interesting letter afforded you.

Geo. J. Somerville.

We shall be glad if our correspondents who desire to make any replies in this correspondence will so word their letters as to make it unnecessary to have any counter replies. If this be done we think it may be possible to close the correspondence next week.—EDS. ELEC. REV.